Minnesota Water Resources Conference

Program and Abstracts

October 13–14, 2015

Saint Paul RiverCentre
175 West Kellogg Boulevard
Saint Paul, Minnesota

www.wrc.umn.edu/waterconf

Minnesota Water Resources Conference

October 13–14, 2015

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Minnesota Water Resources Conference

October 13–14, 2015

Exhibitors

We thank our exhibitors at the Water Resources Conference:

2015 Water Resources Planning Committee

John Baker, U.S. Department of Agriculture, and Department of Soil, Water, and Climate, University of Minnesota

Ann Banitt, U.S. Army Corps of Engineers

Jeff Berg, Minnesota Department of Agriculture

John Bilotta, MN Sea Grant, University of Minnesota Extension

Sue Borowick, College of Continuing Education, University of Minnesota

Tina Carstens, Ramsey-Washington Metro Watershed District

Heather Dorr, College of Continuing Education, University of Minnesota

Bill Douglass, Bolton & Menk, Inc.

Lisa Goddard, SRF Consulting Group, Inc.

Lorin K. Hatch, HDR Engineering, Inc.

Andrea Hendrickson, Minnesota Department of Transportation

Kimberly Hill, St. Anthony Falls Laboratory, University of Minnesota

Karen Jensen, Metropolitan Council

Stephanie Johnson, Mississippi Watershed Management Organization

Ron Leaf, Short Elliott Hendrickson, Inc.

Salam Murtada, Department of Natural Resources, Division of Waters

* *Randy Neprash,* Minnesota Cities Stormwater Coalition & Stantec

Shawn Schottler, St. Croix Watershed Research Station

Wayne Sicora, Natural Resource Group

* *Faye Sleeper,* Water Resources Center, University of Minnesota

Gene Soderbeck, Minnesota Pollution Control Agency

James Stark, U.S. Geological Survey

Katy Thompson, ASCE Representative & WSB & Associates, Inc.

Stew Thornley, Minnesota Department of Health

Rick Voigt, Voigt Consultants, LLC

Greg Wilson, Barr Engineering Company

Brad Wozney, Minnesota Board of Soil and Water Resources

* *Committee Co-Chairs*

Program Schedule – Tuesday, October 13, 2015

8:00 – 8:10 **Welcome**
Faye Sleeper, Water Resources Center, University of Minnesota

8:10 – 8:20 **Dave Ford Water Resources Award**

8:20 – 9:30 **Plenary Session**
Managing Nutrient Reduction at the Watershed Scale: Early Lessons Learned from the Chesapeake Bay TMDL
Tom Schueler, Executive Director of Chesapeake Stormwater Network

9:30 – 10:00 **Break**

10:00 – 11:30 Concurrent Sessions I

Track A Rooms 1-3

Surface Water Effects on Groundwater Quality and Quantity

Moderator: *Karen Jensen,* Metropolitan Council

Co-Moderator: *Gene Soderbeck,* Minnesota Pollution Control Agency

Initial Township Testing Results for Nitrate in Private Wells

Kimberly Kaiser, and *Nikol Ross,* Minnesota Department of Agriculture

Flood Effects on Surface Water - Groundwater Connectivity in Entrenched Stream Valley, Shallow Groundwater Systems - East Branch Amity Creek, Duluth, Minnesota

Jenny Jasperson, Minnesota Pollution Control Agency; *Karen Gran*, University of Minnesota Duluth; *Joe Magner*, University of Minnesota; *John Swenson,* University of Minnesota Duluth

Estimating Salt Budgets to Predict Chloride Threats to Municipal Wells

John Jansen, Leggette, Brashears and Graham

Track B Rooms 4-6

New Hydrology Methods and Case Study

Moderator: *Andrea Hendrickson,* Minnesota Department of Transportation

Co-Moderator: *Lisa Goddard,* SRF Consulting Group, Inc.

NOAA Atlas 14 Rainfall Depths, NRCS Rainfall Distributions, and Dimensionless Unit Hydrographs

Amanda Smith, Natural Resources Conservation Service

Determining Effective Impervious Area for Stormwater Runoff in Un-Gauged Urban Watersheds

Ali Ebrahimian and John Gulliver, St. Anthony Falls Laboratory, University of Minnesota; *Bruce Wilson,* Department of Bioproducts and Biosystems Engineering, University of Minnesota

Designing a City for Zero Stormwater Discharge

Brett Emmons, and *Carl Almer*, Emmons & Olivier Resources

Track C Ballroom C

Assessing Nutrient Reductions from Agricultural Systems

Moderator: *Greg Wilson*, Barr Engineering Company

Co-Moderator: *Shawn Schottler,* St. Croix Watershed Research Station

Wetlands and Lakes Reduce Surface Water Nitrogen Losses from Minnesota's Agricultural Landscapes

Amy Hansen, St. Anthony Falls Laboratory, University of Minnesota; *Christine Dolph and Jacques Finlay,* Department of Ecology, Evolution and Behavior, University of Minnesota

Nitrogen Reduction in a Constructed Wetland and Wetland Mesocosms

Brad Gordon, Dean Current, Josh Gamble, and Chris Lenhart, University of Minnesota; *Nikol Ross*, Minnesota Department of Agriculture

Exploring N and P Reduction in Bioreactors

Lu Zhang and Joe Magner, University of Minnesota

Track D Ballroom D

Regulation

Moderator: *Stephanie Johnson,* Mississippi Watershed Management Organization

Co-Moderator: *Randy Neprash,* Minnesota Cities Stormwater Coalition and Stantec Consulting

Alternative Wetland Mitigation Options for Northeastern Minnesota Compensation Siting

Andrea Plevan and Jennifer Olson, Tetra Tech

Watershed District Volume Reduction Rules Ten Years Later

Paige Ahlborg, Ramsey-Washington Metro Watershed District; *Jennifer Koehler,* Barr Engineering Company

Forming a National Association of MS4 Permittees

Randy Neprash, Minnesota Cities Stormwater Coalition and Stantec Consulting

** Underlined names are on-site presenters*

Program Schedule – Tuesday, October 13, 2015 (continued)

11:30 – 12:15 p.m. **Lunch**
Jeffrey Peterson, Water Resources Center, University of Minnesota

12:15 – 1:00 **Luncheon Presentation**
Creating Shared Value – Advancing Water Stewardship through NGO/Industry Collaboration
Ellen Silva, General Mills; *Lisa Kushner,* The Nature Conservancy

1:15 – 2:45 Concurrent Sessions II

Track A Rooms 1-3

Groundwater Extended Session: Groundwater Management in the Next Decade

Part 1: Groundwater Tools

Moderator: *John Baker,* United States Department of Agriculture and University of Minnesota, Soil, Water, and Climate

Co-Moderator: *Karen Jensen,* Metropolitan Council

Groundwater and Surface Water Interactions

Jim Almendinger, St. Croix Watershed Research Station (20 minutes)

County Geologic Atlas (Parts A &B):

A: Geologic Setting

Robert Tipping, Minnesota Geological Survey (15 minutes)

B: Groundwater and Pollution Sensitivity

Jim Berg and Roberta Adams, Minnesota Department of Natural Resources (15 minutes)

Assessing the Minnesota Statewide Potential Groundwater Recharge Rates (1996-2010) For Annual Water Mass Balances

Erik Smith, United States Geological Survey (15 minutes)

Groundwater Tools and Resources for Local Governments

Lanya Ross, Metropolitan Council; *Carrie Raber*, Minnesota Department of Health (15 minutes)

Panel Discussion (10 minutes)

Track B Rooms 4-6

Innovations in Urban Stormwater Management

Moderator: *Lisa Goddard,* SRF Consulting Group, Inc.

Co-Moderator: *Ron Leaf,* SEH

Mississippi Watershed Management Organization's New Headquarters: the Transformation of an Urban Industrial Site

Kurt Leuthold, Barr Engineering Company; *Doug Snyder,* Mississippi Watershed Management Organization

Stormwater Reuse for Irrigation of Edison High School Football Field

Mark Statz and *Dan Edgerton,* Stantec Consulting; *Stephanie Johnson,* Mississippi Watershed Management Organization

Lowertown Ballpark (CHS Field): Managing Runoff Differently

Nate Zwonitzer, Capitol Region Watershed District; *West Saunders-Pearce*, City of Saint Paul

Track C Ballroom C

Agricultural Planning and Assessment Tools

Moderator: *Jeff Berg,* Minnesota Department of Agriculture

Co-Moderator: *Brad Wozney,* Board of Water and Soil Resources

Analysis of the Minnesota Agricultural Water Quality Certification Program's (MAWQCP) Assessment Tool

Peter Gillitzer, Minnesota Department of Agriculture; *Dennis Fuchs*, Stearns County Soil and Water Conservation District; *Ben Jordan,* Sense AI; *James Klang,* Kieser and Associates

Watershed Nutrient Reduction Planning Using N-BMP and P-BMP Spreadsheet Tools

David Wall, Minnesota Pollution Control Agency; *William Lazarus and David Mulla,* University of Minnesota

Cost-Effective Agricultural BMP Planning Using Precision Conservation Principles and Advanced GIS Tools: a Case Study in the Squaw Creek Watershed, Iowa

Jason Ulrich and Patrick Conrad, Emmons & Olivier Resources, Inc.

Track D Ballroom D

Assessing Stormwater Infrastructure and AIS Impact Efforts

Moderator: *Tina Carstens*, Ramsey-Washington Metro Watershed District

Co-Moderator: *John Bilotta,* University of Minnesota Extension and Minnesota Sea Grant Program, Water Resources Center

Aging Stormwater Infrastructure: Using GIS to Assess Failure Risk and Prioritize Improvements

Janna Kieffer, Barr Engineering Company; *Liz Stout,* City of Minnetonka

Stormwater Assessment and Maintenance: Resources and Tools

Andy Erickson, St. Anthony Falls Laboratory; *John Gulliver,* University of Minnesota; *Peter Weiss*, Valparaiso University

How Many Exposures Does It Take to Stop Aquatic Hitchhikers?

Doug Jensen, University of Minnesota Sea Grant Program; *Pat Conzemius,* Wildlife Forever

** Underlined names are on-site presenters*

Program Schedule – Tuesday, October 13, 2015 (continued)

2:45 – 3:15 **Break**

3:15 – 4:45 Concurrent Sessions III

Track A Rooms 1-3

Groundwater Extended Session: Groundwater Management in the Next Decade

Part 2: Groundwater Management and Policy

Moderator: *James Stark,* United States Geological Survey

Co-Moderator: *Salam Murtada,* Minnesota Department of Natural Resources, Ecological and Water Resources Division

Groundwater Sustainability

Steve Thompson, Minnesota Department of Natural Resources (25 minutes)

Groundwater Management Areas:

Overview

Paul Putzier, Department of Natural Resources (10 minutes)

North & East Metro GWMA

Paul Putzier, Department of Natural Resources (10 minutes)

Straight River GWMA

Robert Guthrie, Department of Natural Resources (10 minutes)

Bonanza Valley GWMA

Mark Hauck, Department of Natural Resources (10 minutes)

Groundwater Management:

Characterizing Groundwater and Surface Water Interactions in Selected Northeastern Twin Cities Lakes, Minnesota

Perry Jones, United States Geological Survey (15 minutes)

Panel Discussion (10 minutes)

Track B Rooms 4-6

Stormwater: Trees and Roads

Moderator: *Randy Neprash,* Minnesota Cities Stormwater Coalition and Stantec Consulting

Co-Moderator: *Katy Thompson,* WSB and Associates, Inc.

Understanding the Role of Urban Trees in the Management of Nutrients in Stormwater

Benjamin Janke, Jacques Finlay, and *Sarah Hobbie,* University of Minnesota

Infiltration Performance of Roadside Drainage Ditches

Maria Garcia-Serrana and John S. Gulliver, University of Minnesota, Department of Civil, Environmental and Geo-Engineering; *John L. Nieber,* University of Minnesota, Department of Bioproducts and Biosystems Engineering

Mapping Rivers and Lakes for Highways: Applications of Hydrography in Transportation

Petra DeWall and *Nicole Bartelt,* Minnesota Department of Transportation Bridge Office

Track C Ballroom C

Minnesota Waters: Past, Present and Future

Moderator: *Gene Soderbeck,* Minnesota Pollution Control Agency

Co-Moderator: *Ann Banitt,* United States Army Corps of Engineers

Relationships Between Land Use and Sediment Accumulation in Minnesota Lakes, from Pre-Settlement to Present

Robert Dietz, University of Minnesota; *James Almendinger, Daniel Engstrom, and Shawn Schottler,* St. Croix Watershed Research Station; Science Museum of Minnesota

Swimmable, Fishable, Fixable?

Lee Ganske, Michael Koschak and *Catherine Rofshus,* Minnesota Pollution Control Agency

Sentinel Lakes: A Review of the Past and Look Toward the Future

Steven Heiskary, Minnesota Pollution Control Agency; *Brian Herwig* and *Jeff Reed,* Minnesota Department of Natural Resources

Track D Ballroom D

Engaging Citizens

Moderator: *Stephanie Johnson,* Mississippi Watershed Management Organization

Co-Moderator: *Stew Thornley,* Minnesota Department of Health

The "Luxury of Participation": Urban Water Resource Decision Making and Stakeholder Engagement

Vanessa Perry, and *Mae Davenport,* University of Minnesota

Adopt-A-Drain: Using Behavioral Psychology and Marketing Strategies to Engage Residents in Water Protection

Jana Larson, Hamline University; *Elizabeth Beckman,* Capitol Region Watershed District

Citizen Led Subwatershed Targeting in the Le Sueur River Watershed

Kimberly Musser and *Jessica Nelson,* Minnesota State University, Mankato Water Resource Center

** Underlined names are on-site presenters*

4:45 – 5:45 **Reception and Poster Session**

Program Schedule – Wednesday, October 14, 2015

8:00 – 8:10 **Welcome**
Randy Neprash, Minnesota Cities Stormwater Coalition; and Stantec

8:10 – 9:30 **Plenary Session**
Fracking and the Nexus of Water and Energy
Larry Wackett, University of Minnesota

9:30 – 10:00 **Break**

10:00 – 11:30 Concurrent Sessions IV

Track A Rooms 1-3

Applications of the Gridded Surface Subsurface Hydrological Analysis (GSSHA) Model to Address Hydrological Alterations and Water Quality Impacts

Moderator: *Katy Thompson,* WSB and Associates, Inc.

Co-Moderator: *James Stark,* United States Geological Survey

Development of Techniques to Enhance Field-To-Watershed Soil Modeling Parameterization for Improved Hydrologic Model Predictions Using the Gridded, Physically Based, Process Driven GSSHA Model

Daniel Reinartz, Minnesota Department of Natural Resources

GSSHA Model to Study the Effects of Tile Drainage in a Discovery Farm Field

Salam Murtada and *Greg Eggers,* Minnesota Department of Natural Resources, Ecological and Water Resources Division; *Tim Radatz,* Minnesota Agricultural Water Resource Center, Discovery Farms Minnesota

Track B Rooms 4-6

Stream/Dissolved Oxygen/Biotic

Moderator: *Gene Soderbeck,* Minnesota Pollution Control Agency

Co-Moderator: *Bill Douglass,* Bolton & Menk, Inc.

Stream Channel Restoration to Improve Dissolved Oxygen

Rebecca Kluckhohn and Wes Boll, Wenck Associates; *Dennis Loewen,* Clearwater River Watershed District; *Jeff Strom,* Wenck Associates

Stream Restoration in Hardwood Creek to Address Biotic Impairment

Matt Kocian, Rice Creek Watershed District; *Walter Eshenaur,* SRF Consulting Group, Inc.

Impact of Point and Nonpoint Sources of Organic Matter in the Predicted Summer Daily Average Dissolved Oxygen Concentration in the Metro Reach of the Minnesota River for Low Flows

Aida Mendez, Minnesota Pollution Control Agency

Track C Ballroom C

Protecting Water Quality

Moderator: *Wayne Sicora,* Natural Resource Group

Co-Moderator: *Andrea Hendrickson,* Minnesota Department of Transportation

Valuing and Prioritizing Natural Infrastructure for Source Water Protection and Other Ecosystem Services

Kristen Blann, The Nature Conservancy

Agriculture's Unintended, But Costly Repercussions of Hydrologic Alterations and Its Effect on Projects and Policies

Josh Petersen and *Travis Thiel,* Dakota County Environmental Resources

Geospatial Processing Techniques for Estimating BMP Treatment Train Load Reduction

Jeremiah Jazdzewski and *Mark Deutschman,* Houston Engineering, Inc.; *Charles Fritz,* International Water Institute; *Drew Kessler,* Houston Engineering, Inc.

Track D Ballroom D

Water Quality Improvement Strategies

Moderator: *Brad Wozney,* Board of Water and Soil Resources

Co-Moderator: *Lorin K. Hatch,* HDR Engineering, INC.

Sequential Watershed Monitoring for Targeted BMP Implementation

Meghan Funke, Emmons & Olivier Resources, Inc.

Silver Lake Common Carp Project

Tony Havranek, WSB & Associates

Perseverance and Innovative Problem Solving Culminate in Wirth Lake Delisting

Greg Wilson and *Karen Chandler,* Barr Engineering Company; *Jim de Lambert,* Bassett Creek Watershed Management Commission; *Jim Herbert,* Barr Engineering Company; *Laura Jester,* Bassett Creek Watershed Management Commission; *Jeff Oliver,* City of Golden Valley

LID Workshop Rooms 7-9

Part I:

Lessons Learned in Managing Stormwater at New and Existing Development in the Chesapeake Bay Watershed

Tom Schueler, Executive Director of Chesapeake Stormwater Network

** Underlined names are on-site presenters*

Program Schedule – Wednesday, October 14, 2015 (continued)

11:30 – 12:15 p.m. Lunch

12:15 – 1:00 Luncheon Presentation
Reflections on Water
Len Price, Conservation Corps Minnesota and Iowa

1:15 – 2:45 Concurrent Sessions V

Track A Rooms 1-3

Mapping Technologies

Moderator: *Ann Lewandowski,* Water Resources Center

Co-Moderator: *Wayne Sicora,* Natural Resource Group

An Improved National Wetland Inventory for Southern Minnesota

Steve Kloiber, Minnesota Department of Natural Resources; *Andy Robertson* and *Dave Rokus,* St. Mary's University of Minnesota

Regional Lake Water Quality Measurements Using New Enhanced Satellite Remote Sensing Systems

Leif Olmanson, Marvin Bauer, Patrick Brezonik, and Jacques Finlay, University of Minnesota

Mapping Minnesota's Next Generation of Hydrography (NXG-Hydro) from LiDAR-Derived Products

Sean Vaughn, Minnesota Information Technology at Minnesota Department of Natural Resources

Track B Rooms 4-6

Stream Restoration

Moderator: *Rick Voigt,* Voigt Consultants, LLC.

Co-Moderator: *Ron Leaf,* SEH

Using Natural Channel Design to Restore Both Physical and Ecological Function to Unstable Streams. How a system based approach to setting objectives led to the Stewart River Natural Channel Design restoration project

Karl Koller, Minnesota Department of Natural Resources; *Ann Thompson,* Lake County Soil and Water Conservation District; *Keith Anderson,* Northeast Soil and Water District Technical Service Area; *Dan Schutte*, Lake County Soil and Water Conservation District

Geomorphic Characteristics, Processes, and Responses of Duluth-Area Streams

Christopher Ellison and *Faith A. Fitzpatrick,* United States Geological Survey

Ravine Erosion, Baseflow and Private Property: an Urban Stormwater Management Trifecta

Anna Eleria, Capitol Region Watershed District; *Todd Shoemaker*, Wenck Associates

Track C Ballroom C

Ag and Water Quality

Moderator: *Ann Banitt,* United States Army Corps of Engineers

Co-Moderator: *Stew Thornley,* Minnesota Department of Health

Changes in Hydrology and Water Quality After Conversion of Perennial Vegetation to Cropland in Southwest Minnesota

David Tollefson, Minnesota Department of Agriculture; *Adam Birr,* Minnesota Corn Growers Association; *Jeffrey Strock,* University of Minnesota, Southwest Research and Outreach Center

Climate Effects on Nitrogen Losses from a Tile Drained Watershed in Southern Minnesota

Satish Gupta, Melinda Brown and Andrew Kessler, University of Minnesota

Nitrates in Drainage Water in Minnesota

Brad Carlson, University of Minnesota Extension; *Gyles Randall* and *Jeff Vetsch,* University of Minnesota

Track D Ballroom D

Advances in Wastewater Research and Assessment

Moderator: *Karen Jensen,* Metropolitan Council

Co-Moderator: *Gene Soderbeck,* Minnesota Pollution Control Agency

Performance of a Composite Bioactive Membrane for Enhanced BioH2 Production and Capture from Wastewater

Ana Prieto, William Arnold, and Paige Novak, University of Minnesota

The Effect of Antibiotic Use on Raw Sewage in Municipal Wastewater Treatment Plants

Kyle Sandberg, and *Timothy LaPara* ,University of Minnesota

Estrone Removal in Treatment Systems Designed for Nitrogen Removal

Kira Peterson, Paige Novak, and *David Tan,* University of Minnesota

LID Workshop Rooms 7-9

Part II:

The State of the Minnesota MIDS (Minimum Impact Design Standards): An Update on Implementation, Adoption, and Case Studies Including the Status of MN MIDS including Performance Goals, Calculator and the Community Assistance Package

Led by: *Anne Gelbmann,* Minnesota Pollution Control Agency

** Underlined names are on-site presenters*

2:45 – 3:00 Break

Program Schedule – Wednesday, October 14, 2015 (continued)

3:00 – 4:30 Concurrent Sessions VI

Track A Rooms 1-3

Wild Rice: Research and a Tool for Economic Evaulation for Traditional Values

Moderator: *Faye Sleeper,* Water Resources Center

Co-Moderator: *Katy Thompson,* WSB & Associates, Inc.

MPCA's Proposal for Protecting Wild Rice from Excess Sulfate

Edward Swain and Phil Monson, Minnesota Pollution Control Agency

Accounting for Traditional Values: an Ecosystem Services Valuation for the St. Louis River Watershed

Nancy Schuldt, Fond du Lac Band of Lake Superior Chippewa; *Angela Fletcher*, Earth Economics

Track B Rooms 4-6

Rivers

Moderator: *Ron Leaf,* SEH

Co-Moderator: *Rick Voigt,* Voigt Consultants, LLC.

Identifying Hotspots of Channel Migration in the Minnesota River Basin

Jonathan Czuba, University of Minnesota, Twin Cities; *Patrick Belmont,* Utah State University; *Efi Foufoula-Georgiou,* University of Minnesota, Twin Cities; *Karen Gran*, University of Minnesota, Duluth; *Peter Wilcock,* Utah State University

Riding the Wave of the Latest Dam Breach Modeling: HEC-RAS 2D

Paul Dierking, HDR, Inc.; *Amanda Smith*, Natural Resources Conservation Service

Minnesota River Bank Stabilization Results

Shanna Kent and *Scott Morgan,* Minnesota Department of Transportation

Track C Ballroom C

Ag Drainage/Storage

Moderator: *Shawn Schottler,* St. Croix Watershed Research Station

Co-Moderator: *Greg Wilson,* Barr Engineering Company

Conservation Drainage: Innovative Strategies That Provide Win-Win Solutions

Chuck Brandel, ISG; *Craig Austinson,* Blue Earth County Ditch Authority

A Landscape-Level Analysis to Identify Drainage Water Management Opportunities

Jennifer Olson and *Peter Cada,* Tetra Tech

Linking Water Storage BMPs to Watershed Goals

Jessica Nelson, Water Resources Center, Minnesota State University Mankato; *Jim Klang*, Kieser & Associates, LLC

Track D Ballroom D

Contaminants in Our Waters

Moderator: *Jeff Berg,* Minnesota Department of Agriculture

Co-Moderator: *Gene Soderbeck,* Minnesota Pollution Control Agency

Neonicotinoid Pesticides in Minnesota Groundwater

Brennon Schaefer and *Bill VanRyswyk*, Minnesota Department of Agriculture

Wetland Pesticide Monitoring in Minnesota

Matthew Ribikawskis, David Tollefson, and *Bill VanRyswyk,* Minnesota Department of Agriculture

Sources, Transport, and Sediment–Water Distributions of Contaminants of Emerging Concern in a Mixed-Use Watershed

David Fairbairn, William Arnold, Brian Barber, M. Ekrem Karpuzcu, Elizabeth Kaufenberg, William Koskinen, Paige Novak, Pamela Rice, and *Deborah Swackhamer,* University of Minnesota

LID Workshop Rooms 7-9

Part III:

Stormwater Research Priorities and Establishing a Stormwater Research Council

Led by: *Cliff Aichinger, John Gulliver,* and *John Chapman*

** Underlined names are on-site presenters*

4:30 Adjourn

Poster Display

The following posters will be displayed during the breaks each day. The poster session with poster presenters will be held on Tuesday evening, during the reception.

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1. Using HSPF in TMDL Development
Drew Ackerman, Julie Blackburn, Cindie McCutcheon, and *Bruce Wilson,* RESPEC

2. Minnesota Hydrogeology Atlas: a State-Wide Compilation Series for Minnesota's Hydrogeology
Roberta Adams, Jim Berg, and *Todd Petersen,* Minnesota Department of Natural Resources

3. Stormwater Utility Referendum Adoption - Non Profit's Approach for Success
James Bachhuber and *Caroline Burger,* Brown and Caldwell

4. Modeling Management and Vegetation Impacts on Nutrient, Sediment and Water Flow Changes in the Redwood River
Nathaniel Baeumler, University of Minnesota; *Brent Dalzell,* University of Minnesota, Department of Soil, Water and Climate

5. Co-Occurrence Patterns for Contaminants of Emerging Concern in Tributaries to the Great Lakes
Mark Brigham, United States Geological Survey; *Joann Banda* and *Steven Choy,* United States Fish and Wildlife Service; *Sarah Elliott*, United States Geological Survey; *Daniel Gefell,* United States Fish and Wildlife Service; *Richard Kiesling* and *Kathy Lee,* United States Geological Survey; *Jeremy Moore,* United States Fish and Wildlife Service; *Heiko Schoenfuss*, Saint Cloud State University

6. Rethinking Teaching and Learning Stormwater Practices: A National Resource for Professionals
Eleanor Burkett and *Shahram Missaghi,* University of Minnesota

7. On-Farm Phosphorus Import/Export Analysis to Improve Water Quality
Les Everett, University of Minnesota Water Resources Center; *Jose Hernandez* and *Randy Pepin,* University of Minnesota Extension

8. Mercury in Odonata Larva in the St. Louis River Estuary
Daniel Fraser, University of Minnesota Duluth; *Jeff Jeremiason,* Gustavus Adolphus College; *Nathan Johnson,* University of Minnesota Duluth

9. A New Resource for Assessing Contaminants of Emerging Concern in Minnesota Waters
Christopher Greene, Minnesota Department of Health; *Sarah Elliott,* United States Geological Survey

10. Quantifying Thermal Loading to Brown's Creek
William Herb, University of Minnesota; *Camilla Correll* and *Mike Majesky,* Emmons & Olivier Resources

11. Using Artificial Floating Islands to Limit Sediment Resuspension in Shallow Lakes
Bryce Hoppie and *Kelly Hunt,* Minnesota State University, Mankato

12. Quantifying the Iron-Based Sulfide Absorption Capacity of Aquatic Sediment and Iron Minerals
Nathan Johnson, Aaron Mika, and *Nicholas Osmundson*, University of Minnesota Duluth

13. Scenario Application Manager (SAM): a Statewide Implementation Decision Support Tool
Seth Kenner and *Julie Blackburn*, RESPEC

14. Highway 99 Slope Repair Project
Shanna Kent and *Scott Morgan,* Minnesota Department of Transportation

15. Fundamental Watershed Factors Influencing the Transport of Nitrogen to Streams
Scott Kronholm, University of Minnesota; *Paul Capel and Silvia Terziotti*, United States Geological Survey

16. Nitrate Leaching Flux in Bare Mineral Soils
Stephen Labuz, University of Minnesota

17. Sulfur, Iron and Carbon Geochemistry in the Rooting Zone of Wild Rice
Sophie LaFond, Water Resource Science Program, University of Minnesota; *Nate Johnson,* Department of Civil Engineering, University of Minnesota; *John Pastor*, Department of Biology, University of Minnesota Duluth

18. Rice Creek Commons Infrastructure Improvements
Jonathan Libby, Kimley-Horn & Associates, Inc.; *Pamela Massaro,* Wenck Associates, Inc.

19. Pickle Pond - Remediation to Restoration in the St. Louis River Area of Concern
Dendy Lofton, LimnoTech

20. Creek Restoration Action Strategy
Joshua Maxwell, RPBCWD; *Jeff Weiss,* Barr Engineering

21. Estimation of Suspended Sediment Concentrations in a Sandy Minnesota River Tributary Using an in Situ Turbidity Meter
Gustavo Merten, University of Minnesota Large Lakes Observatory Duluth; *Paul Capel*, United States Geological Survey

22. Application of Agricultural Best Management Practices in a Rural Ontario Watershed Using PCSWMM
Cecilio Olivier, Ryan Fleming, Olivia McGuire, and *Michael Talbot,* Emmons & Olivier Resources, Inc.

23. Clear Lake Water Quality Improvements
Tim Olson, Bolton & Menk, Inc.

24. Forest to Field Conversion: Nitrate Loss from Irrigated Crops on Coarse Textured Soils Recently Converted from Forest to Cropland
Ryan Perish, Minnesota Department of Agriculture

25. Exploring Local Capacity to Protect Groundwater
Amit Pradhananga, University of Minnesota; *LeAnn Buck,* Minnesota Association of Soil and Water Conservation; *Mae Davenport,* University of Minnesota; *Sharon Pfeifer,* Minnesota Department of Natural Resources

Poster Display (continued)

The following posters will be displayed during the breaks each day. The poster session with poster presenters will be held on Tuesday evening, during the reception.

26. Protecting Rural Transportation Infrastructure from Increasingly Intense Rain Events and Debris Flows - CSAH 6 and CSAH 12 Flood Repair, Sibley County, MN
Eric Roerish, SRF Consulting Group, Inc

27. Optimizing Performance of Stormwater Infrastructure With Real Time Controls: Success Stories and Applicability to Agricultural Drainage Systems
David Roman, Andrea Braga, and *David Richardson,* Geosyntec Consultants

28. Statewide Riparian Buffer Inventory of Minnesota's Rivers and Streams
John Sandberg and *Andrew Petersen,* Minnesota Pollution Control Agency

29. Field Guide for Maintaining Rural Roadside Ditches
Jesse Schomberg, University of Minnesota Sea Grant

30. RPDCWD Guided On-Line Permitting Management Tool
Kelly Spitzley, HDR, Inc.; *Claire Bleser*, Riley-Purgatory-Bluff Creek Watershed District

31. Filling the Gaps: Water Science At the Frontiers of Environmental and Social Change
Kate Thompson, University of Minnesota

32. Cedar River - Watershed Modeling Project
Bill Thompson, Minnesota Pollution Control Agency

33. Modeling Basin Runoff Variability and Compliance to River Standards: Case Studies from Northern and Southern River Nutrient Regions of Minnesota
Bruce Wilson and *Julie Blackburn,* RESPEC

34. Feasibility of Using Industrial Anion Exchange Resin to Remove Nitrate from Tile Water
Kari Wolf, University of Minnesota

35. Retrofitting the Miller Hill Mall for Trout: Modeling and Designing Green Infrastructure That Decreases the Temperature of Stormwater Runoff
Heather Wright Wendel, Barr Engineering Co

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175 West Kellogg Boulevard
Saint Paul, Minnesota

Book of Abstracts

Arranged by session in order of presentation
Index of first authors on page 66

Plenary Session 1 8:20 a.m. – 9:30 a.m.

Managing Nutrient Reduction at the Watershed Scale: Early Lessons Learned from the Chesapeake Bay TMDL

Tom Schueler, Executive Director of Chesapeake Stormwater Network

Concurrent Session I 10:00 a.m. – 11:30 a.m.

Track A: Surface Water Effects on Groundwater Quality and Quantity

Initial Township Testing Results for Nitrate in Private Wells

Kimberly Kaiser (Kimberly.kaiser@state.mn.us) and Nikol Ross (Nikol.Ross@state.mn.us), Minnesota Department of Agriculture

The revised Minnesota Nitrogen Fertilizer Management Plan (NFMP) outlines a new Township Testing Program (TTP) to identify and map groundwater nitrate levels at the township scale. The Minnesota Department of Agriculture works with local partners including counties and soil and water conservation districts to coordinate private well nitrate sampling and testing using state Clean Water Funds.

Sixty townships from eight counties have participated in the TTP since 2013. Benton, Dakota, Morrison, Sherburne, Stearns, Olmsted, Wadena and Washington counties were chosen for the initial sampling based on land use practices, groundwater sensitivity, a history of elevated nitrate levels and strong local partnerships. In 29 of the tested townships 10% or more of the wells were found to exceed the 10 mg/L Health Risk Level for nitrate-nitrogen.

Results from the TTP will help guide the type of response necessary to address nitrate in groundwater as outlined in the NFMP.

Flood Effects on Surface Water-Groundwater Connectivity in Entrenched Stream Valley, Shallow Groundwater Systems –East Branch Amity Creek, Duluth, MN

Jenny Jasperson (jenny.jasperson@state.mn.us), Minnesota Pollution Control Agency; Karen Gran (kgran@d.umn.edu), University of Minnesota Duluth; Joe Magner (magne027@umn.edu), University of Minnesota; John Swenson (jswenso2@d.umn.edu), University of Minnesota Duluth

Climate trend models for the Midwest predict future changes in temperature, annual precipitation, and storm event frequency for Northern Minnesota. Streams along the North Shore of Lake Superior are susceptible to increased temperatures, insufficient summer flows, and increased sedimentation through mass wasting, due to climate change and the unique regional geology. Understanding groundwater-surface water hydrology interactions, watershed connectivity, and related flood-induced geomorphic and hydrologic changes is important because they relate to the overall stability and aquatic health of the stream and the biological communities that inhabit it. A 500-year storm hit Duluth, MN on June 19-20th 2012, producing 8-inches of rain in a 24-hour duration which resulted in mass flooding across the region. The Minnesota Pollution Control Agency (MPCA) and University of Minnesota are implementing a surface water-groundwater interaction study in the lower East Branch Amity Creek watershed in Duluth, MN, focusing on 500-year flood effects on surface water-groundwater hydrology and channel geomorphology. The study reach is incising through clay-rich glacial tills overlying bedrock, and has avulsed multiple times in the past, stranding discrete remnant channels cut into till. Pre-flood and post-flood groundwater and surface water level and temperature data were collected through a series of piezometers with pressure transducers and an in-channel stream gage. Stable isotope analyses of Deuterium and Oxygen-18 were conducted on water samples with varying temporal and spatial variability to provide information on flood-induced changes in source hydrology. The overall project goal is to locate areas of subsurface storage and corresponding capacity, understand groundwater-surface water interactions and variability, and identify flood-induced hydrological and geomorphological changes. Preliminary results show a correlation between incision in main stem and remnant floodplain channels and a lowered water table, following the flood. Isotope analysis indicates a change in subsurface source water. Because much of the greater North Shore of Lake Superior has the same geology as the study area, the results of this study may provide insight to hydrology studies of other North Shore of Lake Superior streams.

Concurrent Session I 10:00 a.m. – 11:30 a.m.

Track A: Surface Water Effects on Groundwater Quality and Quantity *(continued)*

Estimating Salt Budgets to Predict Chloride Threats to Municipal Wells

John Jansen (John.Jansen@lbgmn.com), Leggette, Brashears, and Graham

Chloride levels are rising in surface water and groundwater in the northern tier of states. Isotopic analysis indicates that the primary culprit is road salt. We recently completed a pilot study on the South Well Field for the City of Marshfield, WI. The well field consists of 4 sand and gravel wells. Chloride levels have risen from below 10 ppm to over 170 ppm in the well field. The Utility was concerned that additional increases would make the well field unusable. We estimated the salt budget of the aquifer by calculating salt loading rates in the capture zone of the well field and predicting future concentrations based on recharge rates and estimated infiltration of salt. The results indicated that the chloride levels of the well field is approaching steady state and that better salt management practices will be successful in reducing concentrations in the near future. This analysis is a screening tool to identify which wells are at greatest risk for reaching unacceptable chloride levels.

Concurrent Session I 10:00 a.m. – 11:30 a.m.

Track B: New Hydrology Methods and Case Study

NOAA Atlas 14 Rainfall Depths, NRCS Rainfall Distributions, and Dimensionless Unit Hydrographs

Amanda Smith (Amanda.smith2@usda.gov), Natural Resources Conservation Service

In 2013 National Oceanic and Atmospheric Administration Atlas 14 (NOAA Atlas 14, Version 2, Volume 8), was released. NOAA Atlas 14 replaced U.S. Weather Bureau Technical Paper 40 (TP-40) which was initially published in 1961. NOAA Atlas 14 used 405 data sets in Minnesota, has an average record length of over 50 years, has rainfall durations of 5 minutes to 60 days, and rainfall frequencies of 1 year to 1000 year events. Natural Resources Conservation Service (NRCS) created 6 rainfall distributions (MSE 1-6) to be used with NOAA Atlas 14 rainfall depths. MSE 1-6 replaced Type I, Ia, II, and III distributions that had been previously used with TP-40. Minnesota NRCS is using rainfall distribution MSE 3 for the entire state, even though parts of the state are MSE 2 and MSE 4. The standard dimensionless unit hydrograph has a peak rate factor of 484. The peak rate factor of a dimensionless unit hydrograph essentially controls the volume of water on the rising and recession limbs of the hydrograph. Minnesota NRCS has adopted using an adjusted dimensionless unit hydrograph with a peak rate factor of 400, which decreases discharges compared to using the standard dimensionless unit hydrograph with a peak rate factor of 484.

Determining Effective Impervious Area for Stormwater Runoff in Un-Gauged Urban Watersheds

Ali Ebrahimian (ebrah034@umn.edu) and John S. Gulliver (gulli003@umn.edu), St. Anthony Falls Laboratory, Department of Civil, Environmental, and Geo-Engineering, University Of Minnesota; Bruce N. Wilson (Wilson@umn.edu), Department of Bioproducts and Biosystems Engineering, University of Minnesota

Impervious surfaces have been identified as an indicator of the impacts of urbanization on water resources. The design of stormwater control measures (SCMs) is often performed using the total impervious area (TIA) in a watershed. Recent studies have shown that a better parameter for these designs is the "effective" impervious area (EIA), or the portion of total impervious area that is hydraulically connected to the storm sewer system. Methods to improve estimates of EIA are not highly researched, and need further investigation.

The overall goal of this project was to develop a method to estimate EIA in urban watersheds with data that is readily available. First, we improved the existing rainfall-runoff method for EIA determination by reducing the uncertainty associated with EIA estimates and applied it to 40 gauged urban watersheds with different sizes and hydrologic conditions, mostly in the Twin Cities metro area of MN and Austin, TX. The results were then utilized to develop a new method based on the integration of GIS and NRCS-Curve Number (CN). The GIS-CN method is applicable to un-gauged watersheds and is able to estimate EIA fraction based on TIA and soil type which are both readily available from national spatial datasets. The results were used to evaluate the potential and the limitations of the GIS-CN method. The outcome and applications of this study improves the rainfall-runoff modelling in urban watersheds and will eventually lead to the design of a more sustainable urban stormwater infrastructure.

Concurrent Session I 10:00 a.m. – 11:30 a.m.

Track B: New Hydrology Methods and Case Study (continued)

Designing a City for Zero Stormwater Discharge

Brett H. Emmons (bemmons@eorinc.com) and Carl Almer (calmer@eorinc.com), Emmons & Olivier Resources

Stormwater management in a 3,000-acre, hydrologically land locked area in the City of Inver Grove Heights, MN became an obstacle for the community's growth. The traditional stormwater management approach proved to be cost prohibitive. Driven by cost and impact concerns to the surrounding Marcott Lakes and Mississippi River, the City implemented a strict, zero stormwater runoff discharge policy for all development in the area.

As a 2015 National Award Winning project for Excellence in Engineering, EOR's zero-runoff stormwater management approach is a paradigm shift from the traditional 'pipe-and-pump' systems to an enhanced low impact development (LID) approach. The enhanced LID-system significantly reduced the area's initial infrastructure capital cost by $18 million, or $30 million on a lifecycle basis. "Argenta Hills", one of the first developments in the area, proved to be very challenging. It included a large commercial retail and an extensive single family residential development. EOR took advantage of the site's natural topography by maintaining its regional depressions, mimicking natural hydrology and maximizing infiltration opportunities. Infiltration was maximized by strategically locating an extensive "Treatment Train System" of: raingardens, ribbon curbs, curb cuts, porous pavement areas, pervious paver intersections, vegetated swales, and infiltration basins. Not only did this approach reduce cost, it also helped in retaining some of the site's unique natural characteristics while adding amenities such as green streets and open space.

These new, creative approaches in landlocked stormwater management introduced by EOR, generated a new framework and opportunity for the city of Inver Grove Heights to become the first-of-its-kind in the country to rely solely on enhanced LID-type technologies to accomplish, a zero-runoff system matching the landlocked nature of the area.

Concurrent Session I 10:00 a.m. – 11:30 a.m.

Track C: Assessing Nutrient Reductions from Agricultural Systems

Wetlands and Lakes Reduce Surface Water Nitrogen Losses from Minnesota's Agricultural Landscapes

Amy Hansen (hanse782@umn.edu), St. Anthony Falls Laboratory, University of Minnesota; Christine Dolph (dolph008@umn.edu), and Jacques Finlay (jfinlay@umn.edu), Department of Ecology, Evolution and Behavior, University of Minnesota

Excess nitrogen in Minnesota streams and rivers have contributed to local and downstream water quality impairments. We investigated the effects of existing wetlands and lakes, with long water residence times and often anoxic benthic conditions, on surface water nitrogen and sediment denitrification rates in ditches, streams and rivers within an agricultural landscape using an extensive spatial and temporal sampling campaign during 2013 - 2015. We found that nitrate concentrations, during late spring when streamflow and nitrate loading is greatest, were dependent on the percent of the contributing drainage area composed of wetlands or lakes. This result was still significant after controlling for percent cropland. Ecosystem benefits such as enhanced dissolved organic carbon and reduced nitrate concentrations were realized for relatively small wetland area and extended beyond the physical boundary of the wetland suggesting that wetland creation or restoration could be an effective tool for addressing Minnesota's nitrogen reduction goals.

Nitrogen Reduction in a Constructed Wetland and Wetland Mesocosms

Brad Gordon (gordo402@umn.edu), Dean Current, Josh Gamble, and Chris Lenhart (lenh0010@umn.edu), University of Minnesota; Nikol Ross, Minnesota Department of Agriculture

The need for understanding the effectiveness of constructed treatment wetlands in Minnesota continues to grow in order to limit the amount of nitrogen and phosphorous released into the Mississippi River and other freshwater bodies in the state. In 2013 a 0.54 acre, 3-cell treatment wetland was constructed to remove nitrates from row-crop tile drainage discharging into Elm Creek in southern Minnesota. This continuing study aims to understand the effectiveness of this constructed wetland as well as the contributions of the ecology in the wetland at reducing nitrogen and phosphorus flowing into the nearby creek from tile drainage. Water sampling results indicate an improvement in nitrate load reduction of 37.1-43.3% in the first growing season to 49.5-57.2% reduction in the second season. The vegetation and soil are currently being studied using wetland mesocosms to better understand the contributions of some of the wetland's plant species and soil in denitrification as well.

Exploring N and P Reduction in Bioreactors

Lu Zhang (zhang856@umn.edu) and Joe Magner (magne027@umn.edu), University of Minnesota

Woodchip bioreactors have proven effective in removing nitrate-nitrogen (NO3-N) from agriculturally drained water in the Midwest USA region. Both nitrate and phosphorus can lead to hypoxia and algal blooms in the receiving surface waters and degrade the water quality. This study explored the effectiveness of bioreactor technology in removing NO3-N and orthophosphate, and the emission of N2O from different media. Three types of media were examined in a pilot-scale lab experiment: deciduous mixed hardwood chips, biochar chips (created from the same type of woodchip), and corn cobs. Chemically formulated water was fed through each system using a residence time of 24 hours and 8 hours. NO3-N reduction occurred in all three media, although biochar showed a relatively longer lag time. On the other hand, biochar provided the highest percentage of orthophosphate reduction. A lower reduction rate and higher nitrate output was observed from the 8 hours retention time. Corn cobs showed the highest total nitrate removal rate. The orthophosphate reduction rates were not significantly different among the three media. Given the development of state-wide nutrient management plans to reduce nutrient concentrations in surface water, study results of these technologies may help the row-crop producer better manage nutrient export to surface water.

Concurrent Session I 10:00 a.m. – 11:30 a.m.

Track D: Regulation

Alternative Wetland Mitigation Options for Northeastern Minnesota Compensation Siting

Andrea Plevan (andrea.plevan@tetratech.com) and Jennifer Olson (Jennifer.olson@tetratech.com), Tetra Tech

Due to the high prevalence of wetlands and the relative lack of drained wetlands in northeast Minnesota, opportunities for compensatory wetland mitigation through traditional mitigation approaches are limited. The Interagency Northeast Siting Team recommended alternative mitigation options that would target specific aquatic resource functions to benefit the watershed when traditional wetland mitigation opportunities are not available. This US EPA project further explored the options and provided landscape-level analysis to identify potential projects to help agencies support permitees in finding alternative mitigation sites. Alternative mitigation actions evaluated included expanded use of preservation, restoration of riparian corridors, stabilization of natural hydrology, peatland hydrology restoration, and approved watershed plan implementation projects. For each action, spatial data were used to identify potential project locations, which were provided on a HUC-12 watershed basis. Priority watersheds for implementation were determined. This talk will focus on the technical approach, landscape level analysis, limitations of the datasets, and results.

Watershed District Volume Reduction Rules Ten Years Later

Paige Ahlborg (paige.ahlborg@rwmwd.org), Ramsey-Washington Metro Watershed District; Jennifer Koehler (jkoehler@barr.com), Barr Engineering Company

Beginning in 2005, RWMWD worked with Capitol Region Watershed District (CRWD) to research potential rules and standards that would apply to new development and redevelopment in the District. Since the two districts share a boundary, consistency of rules has been appreciated by the common entities.

CRWD and RWMWD meet annually with a joint technical advisory committee to review rules and revise as needed. The most recent updates have been the most drastic since the rules went into place. The April 2015 revisions included increasing our volume reduction standard to 1.1 inches, revising credit given for filtration systems, allowing a higher credit for enhanced filtration systems, and developing a stormwater reuse calculator to determine how much volume reduction credit should be given for stormwater reuse projects. This talk would focus on rule development and the models Barr Engineer Co. developed to determine the recent standards. Emphasis will also be on implementation, applicant concerns, and applicant compliance during the first season the revised rules are in place.

Forming a National Association of MS4 Permittees

Randy Neprash (randy.neprash@stantec.com), Minnesota Cities Stormwater Coalition and Stantec Consulting

For the past year, the author has been part of a very small group working to form a national association of MS4 permittees. The focus of this effort has been state-level and regional coalitions of MS4 cities throughout the United States.

This presentation will provide the following information:

1. The origins of the concept and first steps toward creating a national network of state-level coalitions in 2011. Accomplishments from the conference calls with USEPA staff.
2. A description of the first National Stormwater Summit at WEFTEC 2014 - agenda, participants, products, outcomes of the meeting.
3. Identification and agreement upon goals, objectives, and technical & advocacy needs of the stormwater sector at the national level.
4. Actions and outcomes from meetings and conference calls during 2015 of the network participants.
5. A description of the second National Stormwater Summit and other meetings at WEFTEC 2015 (September 2015) - agenda, participants, products, outcomes of the meeting.
6. Formation of the National Municipal Stormwater Association.

Luncheon Presentation 12:15 p.m. – 1:00 p.m.

Creating Shared Value – Advancing Water Stewardship through NGO/Industry Collaboration

Ellen Silva, General Mills; Lisa Kushner, The Nature Conservancy

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track A: Groundwater Extended Session: Groundwater Management in the Next Decade

Part 1: Groundwater Tools

Groundwater and Surface Water Interactions

Jim Almendinger, St. Croix Watershed Research Station

Aquifer water balance is a fundamental control on groundwater/surface-water interactions. Typically, groundwater is recharged over the landscape between rivers, creating a water-table mound anchored at its edges by the rivers, where groundwater discharges. Water-table height and steepness (gradient) are proportional to recharge. Because perennial lakes and streams are connected to the water table, lake levels and stream baseflows are likewise proportional to recharge. Lake-level response is not spatially uniform but increases with distance from the rivers. Aquifer systems do not equilibrate instantaneously to year-to-year variability in precipitation-driven recharge, and consequently there are lags in lake-level and baseflow response. High-capacity wells can also change aquifer water balance, thus lowering lake levels and river baseflow. Multiple regression was used to relate stream baseflows and lake levels to lagged precipitation and pumping. Isolating the signal of pumping amidst the interannual variability in precipitation-driven recharge is an important challenge in managing our interdependent groundwater/surface-water resources.

County Geologic Atlas (Parts A&B):

A: Geologic Setting

Robert Tipping, Minnesota Geological Survey

Managing groundwater resources requires information on the container it moves through. Minnesota Geological Survey's role in the County Geologic Atlas program is to gather available data on surface and subsurface geologic materials, and map their distribution based on an understanding of geologic processes. Data sources include water well records, soil borings, outcrop exposures, targeted drilling, geophysics, historic reports and soils maps. Resulting maps and GIS datasets are used to build groundwater models, and provide context for interpreting hydrologic data such as surface and groundwater chemistry and water levels in wells. Beginning in 2006, County Geologic Atlas Part A's provide three-dimensional representations of the subsurface – both bedrock and unconsolidated deposits – that are useful both for model inputs and groundwater education. This presentation shows examples of MGS products for individual counties and areas of the state where combined atlases are used for regional groundwater investigations.

B: Groundwater and Pollution Sensitivity

Jim Berg and Roberta Adams, Minnesota Department of Natural Resources

The Minnesota Department of Natural Resources (DNR) County Geologic Atlas (CGA) program produces maps that depict the characteristics and pollution sensitivity of Minnesota's groundwater. A typical atlas describes the distribution of groundwater physical and chemical characteristics, assesses aquifer sensitivity to pollution from surface sources, and includes maps and cross sections with expert interpretations of groundwater flow and age. These documents are used at all levels of government, businesses, and by citizens in long-range planning efforts to protect and preserve groundwater and for short-term emergency response to contaminant releases.

In 2015 the DNR atlas program created the Minnesota Hydrogeology Atlas (MHA) series to compile and update existing hydrogeologic data developed by the County Geologic Atlas program. This program was developed to support regulatory and resource management programs that span county boundaries. All of the CGA and MHA maps and reports are available as downloadable Geographic Information System (GIS) files.

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track A: Groundwater Extended Session: Groundwater Management in the Next Decade (continued)

Assessing the Minnesota Statewide Potential Groundwater Recharges Rates (1996-2010) for Annual Water Mass Balances

Erik Smith, United States Geological Survey

The U.S. Geological Survey, in cooperation with the Minnesota Pollution Control Agency, calculated potential annual groundwater recharge to unconfined aquifers using the Soil-Water-Balance (SWB) model at a one-kilometer resolution for the state of Minnesota for 1996 to 2010. Average annual recharge rates for the modeled period (1996-2010) ranged from less than one to 18 inches per year. These recharge rates can be extracted from the model output grids and used as preliminary recharge estimates for watershed planning and groundwater-flow modeling. As a demonstration of this utility, annual water mass balances were calculated for the surficial groundwater system discharging to the Mississippi River in portions of Sherburne and Wright counties. Recharge estimates derived from the statewide SWB model were used as a source for the water mass balance.

Groundwater Tools and Resources for Local Governments

Lanya Ross, Metropolitan Council; Carrie Raber, Minnesota Department of Health

Minnesota's water resource managers face the challenge of integrating technical information about groundwater and surface water into protection and restoration efforts. To support this work, new tools are being developed at the state and local level.

A statewide project is underway to develop GRAPS – a set of Groundwater Restoration and Protection Strategies that complement WRAPS. GRAPS would support and assist local water resource managers prioritize and target drinking water protection activities in One Watershed, One Plan (1W1P).

In the seven county Twin Cities metropolitan area, Metropolitan Council has developed planning tools to better incorporate groundwater and water supply information into local comprehensive plan updates. Key water supply information is provided at the parcel, community, county and watershed level. This information is part of the region's Master Water Supply Plan and is linked in the Local Planning Handbook, available online, to support local planning work.

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track B: Innovations in Urban Stormwater Management

Mississippi Watershed Management Organization's New Headquarters: The Transformation of an Urban Industrial Site

Kurt Leuthold (kleuthold@barr.com), Barr Engineering Company; Doug Snyder (dsnyder@mwmo.org), Mississippi Watershed Management Organization

The site of the Mississippi Watershed Management Organization's (MWMO) new headquarters successfully integrates innovative stormwater treatment with an enjoyable pedestrian experience and the restoration of ecological function to an urban industrial site.

The MWMO started construction of their new headquarters in 2011. It was very important to them to create a site that met their mission "to lead, and to foster stewardship of the watershed with actions that promote civic ownership and responsibility and through measures that achieve diverse and functional ecosystems." This was a tall order for a heavily altered 1.3 acre urban site on the Mississippi River with a 100 year history of industrial activity. Challenges were many and included deep contaminated fill, stormwater runoff from adjacent properties, very steep slopes to the river, and highly fluctuating river flows.

The objectives for the site were many as well. The MWMO hoped to mimic native hydrology and achieve a near-zero runoff site, not only for their site but also for the runoff from adjacent properties. The goal was to accomplish this using a variety of both proven and experimental stormwater BMPs. It was also important to MWMO to maximize greenspace, save significant trees and reforest the site in order to create vital additional habitat along the Mississippi River flyway.

The first half of the site work was completed in 2012 and the remainder was completed in 2014. All the goals and objectives set at the beginning of the project were realized. The presentation will explore a number of strategies used to accomplish the goals including a shared parking plan with the bar next door and the integration of 8 distinct BMPs into the site design. The end result is a pedestrian friendly site with direct access to the edge of the river, numerous educational opportunities, an effective and interesting stormwater treatment system with significant research possibilities, and new habitat along the Mississippi River within the city of Minneapolis.

Stormwater Reuse for Irrigation of Edison High School Football Field

Dan Edgerton (dan.edgerton@stantec.com) and Mark Statz (mark.statz@stantec.com), Stantec Consulting Services Inc.; Stephanie Johnson (sjohnson@mwmo.org), Mississippi Watershed Management Organization

The Edison High School Stormwater Reclamation Project is one component of the larger Green Campus initiative at the School. The project will collect stormwater from the high school gym roof and surrounding area in underground storage and pump it for irrigation of the adjacent football field. The project will be built in conjunction with the addition of a plaza and concessions stand next to the gym. Goals include: (1) Collect and reuse stormwater that previously drained untreated to the Mississippi River; (2) Reduce the use of treated municipal water for ball field irrigation; (3) Educational opportunities for students; (4) Inform and engage Minneapolis's Holland Neighborhood about sustainable stormwater management; and (5) Promote collaboration among stakeholders.

The stormwater management components of the project were funded by the Mississippi WMO. The project is being constructed this summer and expected to be online by fall of 2015. Stormwater monitoring equipment will be installed as part of the project. The goal is to demonstrate the effectiveness of the system, displaying collected data on the volume of water captured and reused through both on-site and web-based communications.

The presentation summarizes design considerations, illustrates construction activities and lessons learned, and discusses collaboration and educational opportunities.

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track B: Innovations in Urban Stormwater Management (continued)

Lowertown Ballpark (CHS Field): Managing Runoff Differently

West Saunders-Pearce (wes.saunders-pearce@ci.stpaul.mn.us), City of Saint Paul; Nate Zwonitzer (nate@capitolregionwd.org), Capitol Region Watershed District

Construction of the new Lowertown Ballpark (CHS Field), home of the St. Paul Saints minor league baseball team, presented unique and challenging opportunities for stormwater management. A partnership between the City of Saint Paul, Capitol Region Watershed District (CRWD), and Metropolitan Council resulted in a suite of BMPs that exceed water quality requirements and create educational opportunities for the expected 400,000 annual ballpark visitors. Learn how runoff was managed differently, including installation of the state's first municipal re-use system for indoor use.

A 27,000 gallon cistern collects rainwater runoff for irrigation and flushing toilets. Other BMPs onsite include rain gardens, filtration swales, tree trenches with engineered Stockholm soil, and underground storage/filtration. BMPs reduce sediment load to the Mississippi River by over 90%. The presenters will review site constraints and how they were addressed, examine design features of the BMPs, highlight lessons learned and discuss what made the project a success.

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track C: Agricultural Planning and Assessment Tools

Analysis of the Minnesota Agricultural Water Quality Certification Program's (MAWQCP) Assessment Tool

Peter Gillitzer (peter.gillitzer@state.mn.us), Minnesota Department of Agriculture; Dennis Fuchs, Stearns County Soil and Water Conservation District; Ben Jordan, Sense AI; James Klang, Kieser and Associates

The MAWQCP has implemented an assessment tool as part of its whole farm planning process to identify and address agricultural risks to water quality. The assessment tool was adapted for Minnesota from the Natural Resource Conservation Service's Water Quality Index for Ag Runoff (WQIag), a model that integrates many complex and interrelated factors impacting water quality into a simple, unitless index score. Utilizing over 600 field-scale evaluations, a rigorous technical review to improve its functionally was completed by a public-private consortium. The review included a sensitivity analysis, literature review and comparison against edge-of-field data. This presentation will cover the findings including the influence of key model variables, such as conservation practices and nutrient management BMPs, on the index score. Additionally, through the comparison of actual monitoring results, the assessment tool showed a response relationship to total suspended solids while other pollutants were less correlated. A framework for annual examination and review of the assessment tool will also be presented.

Watershed Nutrient Reduction Planning Using N-BMP and P-BMP Spreadsheet Tools

David Wall (david.wall@state.mn.us), Minnesota Pollution Control Agency; William Lazarus (wlazarus@umn.edu), Applied Economics Department, University of Minnesota; David Mulla (mulla003@umn.edu), University of Minnesota

Nitrogen and phosphorus reduction spreadsheet tools (N-BMP and P-BMP) were recently developed by the University of Minnesota to assist watershed planners working at the HUC8 watershed and major basin scales. The tools allow users to quickly evaluate various combinations of 16 agricultural BMPs for achieving nutrient reductions in surface waters. The N-BMP tool indicates that the potential to reduce water nitrogen loads across the Mississippi River Basin is highest for successfully established cover crops (24-27%), followed by: fertilizer/manure efficiency gains (11-16% depending on commodity prices); converting riparian and marginal cropland to perennials (9-11%); and treating tile drainage waters (4-5%). The tool also compares BMP efficiencies (costs per lb of nutrient reduced in waters) so that nutrient reduction planning can emphasize the more efficient practices. Nitrogen and phosphorus reduction scenarios developed for multiple HUC8 watersheds showed that the BMP adoption levels and expected costs to achieve nutrient reduction milestones varies greatly among watersheds.

Cost-Effective Agricultural Bmp Planning Using Precision Conservation Principles and Advanced GIS Tools: A Case Study in the Squaw Creek Watershed, Iowa

Jason Ulrich (julrich@eorinc.com) and Patrick Conrad (julrich@eorinc.com), Emmons & Olivier Resources, Inc.

Squaw Creek is a 150,000 acre (HUC-10) watershed in central Iowa experiencing very high levels of stream nitrogen and phosphorus. The watershed is composed of 85% corn/soybean agriculture, 80% of which is estimated to be drain tiled. A management plan was recently completed for the watershed and within this plan a detailed agricultural best management practice (BMP) analysis was conducted. The precision conservation principles and new GIS toolset authored by the USDA's Mark Tomer as part of the Agricultural Conservation Planning Framework (Tomer et al. 2013. Combining precision conservation technologies into a flexible framework to facilitate agricultural watershed planning. Journal of Soil and Water Conservation) was used to locate potential sites for applicable BMPs at the field scale using LiDAR terrain analyses. A SWAT model was constructed to pinpoint priority hot spots for nitrogen (using SWAT's drain tile simulation capabilities) and phosphorus. The field scale BMP analysis was aggregated to the whole watershed level and produced a plan which included total BMP costs, pollutant reductions and cost-effectiveness. The analysis estimated that one or more BMPs implemented in approximately 40% of the watershed's cropland – located in priority hotspot areas -- would yield nitrogen and phosphorus reductions of over 40% at an annual cost of $25 per treated acre (after cost-share). The plan is currently being used to guide BMP project planning and acquisition of grant funding. This BMP planning approach can serve as an important model for creating watershed restoration plans for Minnesota's agricultural watersheds.

Concurrent Session II 1:15 p.m. – 2:45 p.m.

Track D: Assessing Stormwater Infrastructure and AIS Impact Efforts

Aging Stormwater Infrastructure: Using GIS to Assess Failure Risk and Prioritize Improvements

Janna Kieffer (jkieffer@barr.com), Barr Engineering Company; Liz Stout (lstout@eminnetonka.com), City of Minnetonka

The city of Minnetonka has a vast and complex network of ponds, wetlands, lakes, and streams, connected by a stormwater system comprised of over 11,000 pipes. The City recently conducted a vulnerability assessment of its aging storm sewer system to identify high-risk pipes or culverts to be targeted for inspection and replacement. The assessment included a two-step GIS analysis to 1) identify pipe segments with a higher likelihood of failure due to physical pipe characteristics such as material, soil properties, and ground slopes, and 2) assess the consequences of a storm sewer pipe failure, such as the type and degree of damage that may occur. A rating system was developed to identify the highest-risk storm pipes based on failure likelihood, failure consequences and combined risk. The City plans to develop a targeted inspection and replacement program based on the results of the analysis.

Stormwater Assessment and Maintenance: Resources And Tools

Andrew Erickson (eric0706@umn.edu) and John S. Gulliver (gulli003@umn.edu) St. Anthony Falls Laboratory, Department of Civil, Environmental, and Geo-Engineering, University of Minnesota; Peter Weiss (peter.weiss@valpo.edu), Department of Civil Engineering, Valparaiso University

Maintenance is critical for ensuring the proper function and extending the life of stormwater treatment practices. Inspection is the front line for selecting and scheduling most appropriate maintenance activities. Beyond inspection, testing and monitoring can provide quantitative measures of performance to satisfy construction due diligence, regulatory requirements, or compliance with discharge goals. In recent years, many tools and resources have been developed for assessment (inspection, testing, and monitoring) and maintenance of stormwater treatment practices. This talk will showcase several of these resources and tools including books, web manuals, workshops and certification programs. Members of the audience, whether veteran or newcomer to the stormwater field, will benefit by walking away with a full tool belt for inspecting, assessing, and maintaining stormwater treatment practices.

How Many Exposures Does It Take to Stop Aquatic Hitchhikers?

Doug Jensen, (djensen1@umn.edu), University of Minnesota Sea Grant Program; Pat Conzemius (pconzemius@wildlifeforever.org), Wildlife Forever

For two decades, aquatic invasive species (AIS) management has greatly improved based on human dimensions research. Objectives of this study were to test if a heuristic approach could influence awareness and behavior using strategic e-marketing. Heuristics play an important role in decision making and planned actions. Shifting from previous to desired behavior requires positioning of strategic messages. To this end, Stop Aquatic Hitchhikers! campaign partners generated 1.7 billion impressions since 2006. Wildlife Forever, North American Media Group, and Great Lakes Sea Grant collaborated on 5 e-newsletters each with a specific message to anglers. Partners then surveyed anglers to show that strategic communication and outreach featuring Stop Aquatic Hitchhikers! raised awareness and changed behaviors with 97% reporting that they would take action to prevent AIS spread. Results will be compared to conventional approaches. This presentation will discuss methodology and technology used to test how this heuristic approach worked.

Concurrent Session III 3:15 p.m. – 4:45 p.m.

Track A: Groundwater Extended Session: Groundwater Management in the Next Decade

Part 2: Groundwater Management and Policy

Groundwater Sustainability

Steve Thompson, Minnesota Department of Natural Resources

The presentation reflects the work of the Hydrogeology and Groundwater (HGG) Unit, which is responsible for mapping aquifers and their hydrologic properties and producing statewide aquifer sensitivity maps (County Atlas Program). The unit also conducts technical analysis and modeling of hydrogeologic issues. Work focuses on providing quantifiable answers to permit-related hydrologic questions such as: "Will groundwater extraction cause adverse impacts to a nearby calcareous fen or stream?" Or, "Will the mining of silica sand affect local water hydraulics and adversely impact a stream?"

Groundwater Management Areas: Overview

Paul Putzier, Department of Natural Resources

Groundwater is at risk of overuse and contamination throughout Minnesota and in some specific areas of the state this risk is a more urgent issue. Conflicts arising from overuse have the potential to pit diverse groundwater dependent uses, such as drinking water supply, economic growth, and ecosystem needs, against one another. To address concerns about long term sustainable use of groundwater in these areas, and to help assure adequate supplies for future uses, the DNR is defining Groundwater Management Areas (GWMA) and developing management plans. The GWMA represents a geographic area within which groundwater users share a distinct aquifer system or groundwater resource. Users include both those who are required to have appropriation permits and those who do not require permits to use groundwater. The purpose of the GWMA Plan (Plan) is to guide DNR actions in managing the appropriation and use of groundwater within the GWMA over the five years following adoption of the Plan. The Plan will be updated as needed to allow it to continue guiding sustainable groundwater use beyond the initial five years addressed in this first authorization of the Plan.

North & East Metro GWMA

Paul Putzier, Department of Natural Resources

As part of a statewide analysis of groundwater resources the DNR, in coordination with other state agencies, identified the north and east Twin Cities metropolitan area as an area of specific concern where groundwater resources are at particular risk of overuse and degraded quality. Based on this analysis, the DNR initiated a project to designate the state's first Groundwater Management – the North & East Metro GWMA. Several factors led to this decision, the projected population growth and water use in the area, the presence of surface waters that are sensitive to fluctuations in aquifer levels, and the occurrence of known contamination that limits opportunities to use groundwater. Communities, businesses, and agriculture in much of the N&E Metro GWMA are entirely reliant on groundwater as a source of water supply (in contrast, groundwater provides drinking water for approximately 75 percent of the state's citizens).This area includes a number of communities and businesses that are connected through their use of groundwater and their effect on water resources. The DNR believes that the north and east metro area will benefit from the creation of the GWMA plan to direct permitting and other actions to sustainably use groundwater for current and future generations.

Concurrent Session III 3:15 p.m. – 4:45 p.m.

Track A: Groundwater Extended Session: Groundwater Management in the Next Decade (continued)

Straight River GWMA

Robert Guthrie, Department of Natural Resources

The Straight River Groundwater Management Area (SR-GWMA) is one of three groundwater management areas established by the Minnesota Legislature in 2013. Centered along its namesake, the Straight River is a groundwater-fed, cold-water premier trout stream that forms the axis of the GWMA. Groundwater systems in this area are highly complex and involve the interactions of multiple aquifers and surface water resources. Irrigated agriculture accounts for approximately 84 percent of the water appropriated within the SR-GWMA. Much of this water is applied to glacial outwash-derived sandy soils. As such, groundwater resources are also at risk from over use and subject to contamination due to changes in land use and more intensive agricultural utilization. Given these challenges, the DNR is committed to maintain the sustainable use of groundwater in order for high-quality groundwater supplies that are essential to individuals and communities within the SR-GWMA. To address these challenges, the DNR shares responsibility with local government and other state agencies. In its role, the DNR is responsible for groundwater permitting, the approval of water-supply plans, and the promotion of water-conservation measures. The agency has also taken measures to improve its authorization of permitted groundwater uses to meet statutory sustainability mandates. The DNR has and will continue to discuss these advances with citizens and stakeholders within the SR-GWMA.

Bonanza Valley GWMA

Mark Hauck, Department of Natural Resources

As part of a statewide analysis of groundwater resources the DNR has identified as an area of concern southwestern Stearns, eastern Pope, southern Douglas and northern Kandihohi counties – the area known locally as the Bonanza Valley. Groundwater use has risen 5 times faster in the Bonanza Valley than the statewide average over the past 25 years, increasing the risk of overuse and contamination to groundwater and potentially to surface water. In response, the DNR asked community members to advise DNR on the development of a draft plan for the area. When approved by the DNR Commissioner and implemented, the plan would guide DNR actions over a five year period to assure that DNR permitted water use would not harm ecosystems, water quality or the ability of future generations to meet their own needs. This outcome is defined by Minnesota statutes for all groundwater management areas. Agricultural irrigation is the greatest user of groundwater in the Bonanza Valley and communities, businesses, and agriculture in the Bonanza Valley area are heavily reliant on groundwater as a source of water. The Bonanza Valley Groundwater Management area is one of three groundwater management area planning processes initiated by the DNR in 2013.

Groundwater Management:

Characterizing Groundwater and Surface Water Interactions in Selected Northeastern Twin Cities Lakes, Minnesota

Perry Jones (presenting), United States Geological Survey; Jared J. Trost; Jason L. Roth; Donald O Rosenberry; and Melinda L. Erickson

Water levels in White Bear Lake and other northeast Twin Cities lakes have generally decreased since 2003, and are currently at low levels, limiting access and recreational use (i.e., boating, swimming). The U.S. Geological Survey, in cooperation with the Metropolitan Council and Minnesota Department of Health, is conducting a study to characterize groundwater and surface-water interactions in northeast Twin Cities Metropolitan Area lakes, including White Bear Lake, and the response of lake water levels to changes in precipitation and groundwater-flow conditions. The study tasks include 1) statistical analysis of existing hydrologic information for selected northeast Twin Cities Metropolitan Area lakes, 2) stable isotope and age-dating analysis of water samples collected from lakes, precipitation, and wells, 3) assessment of lake water outflow from White Bear Lake, and 4) groundwater-flow modeling of groundwater and surface-water interactions. Study results will be used to assess the impact of groundwater withdrawals on lake levels.

Concurrent Session III 3:15 p.m. – 4:45 p.m.

Track B: Stormwater: Trees and Roads

Understanding the Role of Urban Trees in the Management of Nutrients in Stormwater

Benjamin Janke (janke024@umn.edu), University of Minnesota; Jacques Finlay (jfinlay@umn.edu) and Sarah Hobbie (shobbie@umn.edu), Department of Ecology, Evolution and Behavior, University of Minnesota

Development of urban tree canopy is often considered a stormwater management strategy due to the ability of trees to reduce stormwater volumes through rainfall interception. However, trees also potentially contribute to nutrient export in stormwater through seasonal deposition of leaf litter onto streets and gutters. We address the potential influence on stormwater nutrient fluxes of tree canopy over and near streets through analysis of high-resolution land cover data and several years of water quality monitoring data for primarily-residential urban watersheds across Minneapolis-St. Paul, MN. We found positive correlations between canopy over streets and stormwater phosphorus and suspended solids across watersheds. At the small scale of a 50-ac residential watershed, we investigated the influence of tree species and canopy coverage on the seasonality of nutrient fluxes through block-level sampling of snowmelt and rainfall-runoff in street gutters. The results imply that urban water quality management may need to consider tree species selection in managed boulevards as well as improved timing of street sweeping.

Infiltration Performance of Roadside Drainage Ditches

Maria Garcia-Serrana (garci683@umn.edu) and John S. Gulliver (gulli003@umn.edu), Department of Civil, Environmental and Geo-Engineering, St. Anthony Falls Laboratory, University of Minnesota; John L. Nieber, (nieber@umn.edu), Department of Bioproducts and Biosystems Engineering, University of Minnesota

We are documenting the infiltration performance of roadside drainage ditches (swales) to establish methods by which the ditches can be assigned pollution prevention credit.

We are investigating the observation that for most rainstorm events the overland flow on swale side slopes is in the form of rivulets and not sheet flow. Runoff tests were conducted on a full-scale laboratory model of swale side slopes, and on four roadway swales in the Twin Cities area, each representing a different soil type.

The laboratory and field experiments demonstrate that there is a relationship between the percentage of wetted surface area and the amount of volume infiltrated. The average percentage of water infiltrated for a 2-year event observed in the field was 85%, with the maximum and minimum being 100 and 60 percent, respectively. Further experiments are being conducted using other rain intensities. The results will be incorporated into a Runoff-Infiltration Model for roadside drainage ditches.

Mapping Rivers and Lakes for Highways: Applications of Hydrography in Transportation

Petra DeWall (petra.dewall@state.mn.us) and Nicole Bartelt (Nicole.bartelt@state.mn.us), MnDOT Hydraulics/Waterways Unit

A river's contours are a mystery until they're mapped. Even then, the river moves and changes with high flows and debris. Lakes, though less changeable, are unknowable without depth mapping. This presentation will provide an overview of river and lake hydrography projects done by the Minnesota Department of Transportation Bridge Hydraulics-Waterways group.

MnDOT's Bridge Hydraulics/Waterways group has mapped rivers and lakes for 16 years with survey-grade depth-sounders and an Acoustic Doppler Current Profiler (ADCP). Depths, flow rate, velocity and direction are measured, mapped in ArcGIS and CADD and applied to project requirements. Challenged by floods and low water alike, our equipment has been adapted to a wide variety of waterways, and we'll share that experience. Recently, we acquired a 3D sonar scanner device and will discuss what we have done to date and some exciting prospects for the future.

Concurrent Session III 3:15 p.m. – 4:45 p.m.

Track C: Minnesota Waters: Past, Present and Future

Relationships Between Land Use and Sediment Accumulation in Minnesota Lakes, from Pre-Settlement to Present

Robert Dietz (dietz070@umn.edu), Water Resources Science Program, University of Minnesota; Daniel Engstrom (dre@smm.org), Shawn Schottler (schottler@smm.org) and James Almendinger (dinger@smm.org), St. Croix Watershed Research Station, Science Museum of Minnesota

The native landscapes of Minnesota have undergone enormous transformation since Euro-American settlement, impacting the quantity and timing of sediment fluxes from land to water. We explored historical relationships between land use and terrigenous sediment accumulation (SAR) in 116 lakes spanning 3 ecoregions and multiple land use regimes, including intensive row-crop agriculture. Estimates were constructed using sediment-core chronologies (210Pb, 137Cs) and loss-on-ignition data (% non-carbonate siliciclastic material). In all but 9 lakes, SAR has increased above natural background rates. Median SAR has doubled in northern forested lakes but has not returned toward pre-settlement levels, perhaps due to legacy impacts from earlier logging. In southern agricultural lakes, median SAR has increased more than fivefold, climbing sharply during early land clearance/farming and exhibiting a more muted rise after ~1940 that continues to the present. Lakes affected by urban or mixed land uses show intermediate levels of change.

Swimmable, Fishable, Fixable?

Lee Ganske (lee.ganske@state.mn.us), Michael Koschak (Michael.koschak@state.mn.us) and Catherine Rofshus (catherine.rofshus@state.mn.us), Minnesota Pollution Control Agency

In April of 2015, the Minnesota Pollution Control Agency (MPCA) completed a report titled "Swimmable, Fishable, Fixable? – What we've learned so far about Minnesota waters." Governor Dayton joined MPCA Commissioner John Stine in a press conference releasing the report, which received extensive media coverage. The purpose of the report was to summarize progress on major watershed approach work funded through the Clean Water, Land and Legacy Amendment. Comprehensive water quality assessments have been completed on just over half of the state's 81 major watersheds; the report was thus billed as a "midpoint" in the first 10-year watershed approach cycle. In addition to assessments, key elements of the approach include biological stressor identification, and the development of restoration and protection strategies. Three of the report's authors will review findings, provide updated information gathered since April, and discuss how the report was received by the media and public.

The report can be found at:

www.pca.state.mn.us/index.php/view-document.html?gid=22760

Concurrent Session III 3:15 p.m. – 4:45 p.m.

Track C: Minnesota Waters: Past, Present and Future (continued)

Sentinel Lakes: A Review of the Past and Look Toward the Future

Steven Heiskary (steven.heiskary@state.mn.us) Environmental Analysis &Outcomes Division, Minnesota Pollution Control Agency; Brian Herwig (brian.herwig@state.mn.us) and Jeff Reed Minnesota Department of Natural Resources, Section of Fisheries-Fisheries Research Unit

The Sentinel Lakes Long-Term Monitoring Program, formerly SLICE (Sustaining Lakes in a Changing Environment), is a comprehensive, cooperative, ecological monitoring program. Originally a vision of the MN DNR - Section of Fisheries, MPCA was invited to partner on the effort in 2007. As part of the initial process, 24 lakes representing a wide range of lake types found throughout Minnesota were selected and included in the program. Collaborative monitoring began in 2008 and established baseline water quality, fisheries, zooplankton, macrophyte, and watershed information for all lakes. Environmental Trust Funds supported initial and ongoing work allowing for intensive, collaborative studies assessing the consequences of ecological drivers of change on water quality and habitat dynamics of lakes, including lake modeling, paleolimnological, and stable isotope studies. This presentation provides a brief overview of the program highlighting several associated projects and results that will contribute to lake management in Minnesota. Results to be shared include:

- Initial responses of Carlos, Trout and Greenwood to aquatic invasives;
- Sediment core-inferred historical water quality conditions;
- Curly-leaf pondweed trends and implications for lake management;
- Documenting the recovery of an impaired prairie lake (Shaokatan);
- Groundwater-surface water interaction based on nested wells on 4 lakes.

Concurrent Session III 3:15 p.m. – 4:45 p.m.

Track D: Engaging Citizens

The "Luxury of Participation": Urban Water Resource Decision Making and Stakeholder Engagement

Vanessa Perry (perry597@umn.edu) and Mae Davenport (madaven@umn.edu), University of Minnesota

This study examines research findings on perceptions of water resources and decision making across three Twin Cities watershed management areas: Mississippi Watershed Management Organization, Capitol Region Watershed District, and Ramsey-Washington Metro Watershed District. In collaboration with local partners, University of Minnesota researchers investigated stakeholders' values, beliefs and civic actions associated with water resource protection. A total of 60 key informant interviews were conducted across the 3 watersheds, with a focus on recruiting new immigrant and minority stakeholder participants. Findings indicate that many interviewees perceive limited power to influence water management outcomes, and therefore have low motivation to participate in decision making. Additionally, interviewees identified feeling marginalized in their communities by assumptions made by others in power. A better understanding of drivers and constraints will help managers more effectivity engage stakeholders who have been underrepresented in water resource issues. Final reporting for the study will be completed fall 2015.

Adopt-A-Drain: Using Behavioral Psychology and Marketing Strategies to Engage Residents in Water Protection

Jana Larson (jlarson25@hamline.edu), Hamline University; Elizabeth Beckman (Elizabeth@capitolregionwd.org), Capitol Region Watershed District

Adopt-a-Drain, a pilot program created by Hamline University with support from the City of Saint Paul and Capitol Region Watershed District, is successfully engaging residents in water protection activities. The program was developed using principles from psychology and marketing, and revised using community focus group feedback. Residents sign up online to adopt a storm drain, display a sign in their yard, and act as clean water ambassadors in their neighborhood. During the pilot year, 120 residents participated and, based on reports from 12 residents, diverted approximately 3700 pounds of debris from storm drains.

Presenters will outline concepts from psychology and marketing used to create Adopt-a-Drain, results of focus groups with local residents, lessons learned during implementation in the Como Lake neighborhood of Saint Paul, and insights into the combined use of traditional and social media strategies for environmental communication.

Citizen Led Subwatershed Targeting in the Le Sueur River Watershed

Kimberly Musser (Kimberly.musser@mnsu.edu) and Jessica Nelson (Jessica.nelson-1@mnsu.edu), Minnesota State University, Mankato Water Resources Center

The Le Sueur River Watershed is one of the leading contributors of pollutant loads in the Upper Mississippi River Basin. Researchers and local managers have identified the altered flow regime as a major stressor causing accelerated erosion in rivers and streams. They are seeking ways to re-create more storage, retention, and infiltration in the watershed to hold back water that is destabilizing these systems and contributing to water quality problems.

The GIS-based Agricultural Conservation Planning Framework is being applied in subwatersheds to identify possible beneficial locations for different types practices that promote storage and pollutant reduction. A citizen-led watershed group, Le Sueur River Watershed Network, is using this planning tool to engage neighbors in discussions about targeted conservation opportunities. This local consultative process with landowners based on targeted opportunity areas is a promising route to achieve pollutant reduction goals identified in the Le Sueur River Watershed Restoration and Protection Strategy.

Plenary Session II 8:10 a.m. – 9:30 a.m.

Fracking and the Nexus of Water and Energy

Larry Wackett, University of Minnesota

Concurrent Session IV 10:00 a.m. – 11:30 a.m.

Track A: Applications of the Gridded Surface Subsurface Hydrological Analysis (GSSHA) Model to Address Hydrological Alterations and Water Quality Impacts

Development of Techniques to Enhance Field-To-Watershed Soil Modeling Parameterization for Improved Hydrologic Model Predictions Using the Gridded, Physically Based, Process Driven GSSHA Model

Dan Reinartz (Daniel.j.reinartz@state.mn.us) Division of Waters - Minnesota Department of Natural Resources

The physically based Gridded Surface Subsurface Hydrologic Analysis (GSSHA) model is being used to assess Best Management Practices (BMPs) at sub-field scales up to watershed scales approaching 20,000 acres. A better understanding of the soil parameterization required in GSSHA to represent changes in the soil matrix and how it responds to these measures is necessary to accurately improve hydrologic response and mitigate some of our water quality and quantity issues. The DNR has done extensive research on the latest advancements in science through the USDAs Water Erosion Prediction Project (WEPP) and the Soil-Plant-Air-Water (SPAW) project. This research offers guidance on how to adjust soil properties to account for crop and tillage management practices that impact water balance.

GSSHA Model to Study the Effects of Tile Drainage in a Discovery Farm Field

Salam Murtada (salam.murtada@state.mn.us) and Greg Eggers (greg.eggers@state.mn.us), Minnesota Department of Natural Resources, Ecological and Water Resources Division; Tim Radatz (radatz@mawrc.org), Minnesota Agricultural Water Resource Center, Discovery Farms Minnesota

The ability of Gridded Surface Subsurface Hydrologic Analysis (GSSHA) model to simulate the complex hydrological interactions in the surface and subsurface media at fine spatial and temporal scales makes it a valuable tool for studying the effects of tile drainage on crop growth and drainage water management.

In this study, GSSHA was used to simulate a Discovery Farm field which has been extensively monitored for tile and flume flows, rainfall, and water quality. The monitoring information was then used to calibrate and study the model's various hydrological processes such as surface water runoff, infiltration, groundwater, evapotranspiration, snowmelt and macro-porosity. Finally, the effects of tile drainage on water depth levels and crop growth during the monitored growing seasons were run for various field management scenarios that were not feasible or considered during the monitoring periods. The results of these scenarios were documented and evaluated in order to inform best management practices.

Concurrent Session IV 10:00 a.m. – 11:30 a.m.

Track B: Stream/Dissolved Oxygen/Biotic

Stream Channel Restoration to Improve Dissolved Oxygen

Rebecca Kluckhohn (rkluckhohn@wenck.com), Wes Boll (wboll@wenck.com), Jeff Strom (jstrom@wenck.com), Wenck Associates, Inc.; Dennis Loewen (loewen.dennis@yahoo.com) Clearwater River Watershed District

Stream restoration typically focuses on channel stability. Stabilize banks, provide riffles/ pools and we reduce erosion induced by heavier flows and improve habitat. However, limiting parameters that govern channel design to flow and sediment transport, we limit opportunities to improve dissolved oxygen (DO) and biotic integrity. This talk summarizes data from DO TMDLs and one river restoration to answer the question: Can we optimize channel design to improve DO? Minnesota's 557 bio-assessment impairments often indicate low DO as a stressor. Another 107 waters are explicitly listed for low DO. In-stream DO modeling reveals drivers for DO concentrations and inform restoration techniques. We will assess the impacts of stream morphometry restoration on DO concentrations using TMDL models and a case study where, through channel restoration, we improved DO concentrations, reduced tolerant/ super tolerant species and improved Hilsenhoff Biotic Index (8.26 pre project to 6.08 post project, 5.8 is best-achievable).

Stream Restoration in Hardwood Creek to Address Biotic Impairment

Matt Kocian (mkocian@ricecreek.org), Rice Creek Watershed District; Walter Eshenaur (weshenaur@srfconsulting.com), SRF Consulting Group, Inc.

Hardwood Creek was listed as impaired for biota in 2002. Following the completion of the Hardwood Creek TMDL and Implementation Plan, the Rice Creek Watershed District completed the Hardwood Creek TMDL Implementation Project. This project, finalized in 2014, was designed to decrease sedimentation caused by stream instability, increase habitat diversity, and mitigate impacts from livestock. Primary project features include stream meander restoration, creating a 2-stage channel with a floodplain bench to address channel incision and instability, and livestock management BMP's. This presentation focuses on pre- and post-project monitoring, and addresses the question, "Did this project address the impairment?" Geomorphic survey data indicate a more stable channel. Water quality data indicate reduced concentrations of TSS and BOD, and increased DO. Macroinvertebrate data indicate "very good" stream health, improved from previous years. Secondary project benefits include reduced nutrient delivery to Peltier Lake, which is also impaired.

Concurrent Session IV 10:00 a.m. – 11:30 a.m.

Track B: Stream/Dissolved Oxygen/Biotic (continued)

Impact of Point and Nonpoint Sources of Organic Matter in the Predicted Summer Daily Average Dissolved Oxygen Concentration in the Metro Reach of the Minnesota River for Low Flows

Aida Mendez, (aida.mendez@state.mn.us), Minnesota Pollution Control Agency; Tammy Threadgill (Tammy.L.Threadgill@erdc.dren.mil), United States Army Corps of Engineers, Environmental Research and Development Center; David L. Smith (David.L.Smith@usace.army.mil) Cognitive Ecology and Ecohydraulics Team, United States Army Corps of Engineers, Environmental Research and Development Center

In the past, the concentration of dissolved oxygen (DO) was low in the last 22 miles of the Minnesota River when the flows were low. This had an impact in aquatic life. Part of the problem was caused by phosphorus in and the biochemical oxygen demand of the wastewater discharged by wastewater treatment plants upstream and within this stretch of the Minnesota River (point sources). Action was taken and both parameters were reduced. The Metropolitan Council manages two wastewater treatment plants in this stretch of the river. The Metropolitan Council formed a partnership with The U.S. Army Corps of Engineers (USACE) Engineer Research and Development Center (ERDC) Environmental Laboratory (EL) and other entities to develop a water quality model using the CE-QUAL-W2 framework for facility and watershed planning.

The Minnesota Pollution Control Agency is interested in discerning the current impact that point sources and other sinks of oxygen have on the DO in summer for low flow conditions (7Q10) in this stretch of the Minnesota River. MPCA used the model developed by the USACE-ERDC-EL to estimate these potential impacts.

The model predicts that even if there were no point source discharges in this stretch of the Minnesota River, there would be days in summer when the average daily DO concentration would drop below 5 mg/L which would impact aquatic life. Other scenarios were also studied.

Concurrent Session IV 10:00 a.m. – 11:30 a.m.

Track C: Protecting Water Quality

Valuing and Prioritizing Natural Infrastructure for Source Water Protection and Other Ecosystem Services

Kristen Blann (kblann@tnc.org), The Nature Conservancy

Natural ecosystems such as forests and wetlands provide essential services to water utilities, businesses, and communities—from baseflow regulation and flood control to water quality and temperature regulation. Source water protection strategies that invest strategically in this upstream "natural infrastructure" can reduce the need for grey infrastructure, reduce other costs such as drinking water treatment costs, and provide a suite of co-benefits for communities and the environment. However, these services are threatened by land use change and intensification, increased drainage and irrigation, and increasing extreme weather. Quantification and valuation of source water protection and other services from watershed natural infrastructure can help guide public and private investments to maximize net benefits from alternative future land use and policy scenarios. We used Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST)—a modeling framework and tool for quantifying ecosystem service tradeoffs-- to evaluate where there is greatest overlap in benefits from protection in the Mississippi River headwaters for biodiversity, local resources, and downstream users, under alternative future land use and conservation scenarios. Although there is significant uncertainty in both the biophysical and the valuation results, the approach yields a variety of metrics for evaluating tradeoffs in watershed ecosystem services from realistic future scenarios. Results suggest that strategic investments in protection are not only cost-effective relative to current restoration investments, but critically needed if existing high water quality in the headwaters is to be maintained.

Agriculture's Unintended, But Costly Repercussions of Hydrologic Alterations and Its Effect on Projects and Policies

Josh Peterson (Joshua.petersen@co.dakota.mn.us) and Travis Thiel (travis.thiel@co.dakota.mn.us), Dakota County Environmental Resources

Changes in agricultural land use have had impacts to water quality, quantity, and policies, and the need for local, state, and federal leaders to evaluate current and future policies regarding hydrologic alterations on agricultural lands. Through Dakota County's regulatory, land use authority, environmental compliance and capital improvements implementation roles, we have developed several small case studies to demonstrate these impacts. These studies demonstrate through modeling and observations, how the alterations from adjacent or upstream agricultural lands have increased runoff rates, volumes, and changes to floodplains and wetlands, all of which have resulted in higher capital project costs, infrastructure risk, additional permitting requirements and further degradation to water quality. These issues bring to light some policy considerations at a local, state and federal level, which have broader impacts to our water resources.

Geospatial Processing Techniques for Estimating BMP Treatment Train Load Reduction

Jeremiah Jazdzewski (jjazdzewski@houstoneng.com), Drew Kessler (dkessler@houstoneng.com), and Mark Deutschman (mdeutschman@houstoneng.com), Houston Engineering, Inc.; Charles Fritz (Charles@iwinst.org), International Water Institute

As higher resolution geospatial data becomes available, new geoprocessing techniques are being developed to better estimate physical processes occurring throughout the landscape. Many of these techniques are incorporated in PTMApp, a GIS application developed by the Minnesota Board of Soil and Water Resources and International Water Institute. Techniques in PTMApp include estimating pollutant loading to priority resources and determining suitable locations for best management and conservation practices. Estimating the load reduction of multiple practices (i.e. treatment trains) has proven challenging in many studies. This presentation will outline a novel technique that was developed as part of PTMApp to measure water quality improvements from treatment trains by utilizing the state's LiDAR data. The results provide valuable information for local managers to assist in resource management, implementation planning, and overall budgeting.

Concurrent Session IV 10:00 a.m. – 11:30 a.m.

Track D: Water Quality Improvement Strategies

Sequential Watershed Monitoring for Targeted BMP Implementation

Meghan Funke (mjacobson@eorinc.com), Emmons & Olivier Resources, Inc.

Sequential watershed monitoring was used to focus BMP implementation efforts on phosphorus hotspots in the Moody Lake watershed in the Comfort Lake Forest Lake Watershed District, Minnesota. Flow, phosphorus, and iron were monitored and modeled using FLUX along two main tributaries of Moody Lake. Results indicated that two-thirds of the total phosphorus load originated from just 25% of the total watershed area. In addition, the phosphorus from this small area of the watershed was more bioavailable for algae growth as shown by low iron to phosphorus ratios and high fractions of reactive phosphorus. This monitoring data was used to select locations for wetland rehabilitation BMPs that target the reduction of reactive phosphorus over more traditional BMPs such as buffers or sedimentation basins. Understanding the distribution of phosphorus quality and quantity throughout the Moody lake watershed improved BMP cost-effectiveness by focusing implementation efforts on phosphorus hotspots.

Silver Lake Common Carp Project

Tony Havranek (thavranek@wsbeng.com), WSB & Associates

The Rice Creek Watershed District, Ramsey County Environmental Services, Three Rivers Park District, and the Cities of St. Anthony Village, Columbia Heights, and New Brighton undertook a project in 2013 to actively manage the carp within Silver Lake, Ramsey County. Methodology used development of a mark/recapture estimate, radio telemetry, and commercial fishing. The objectives of the project included:

- Document carp movement within and possibly outside of Silver Lake
- Develop a biomass estimate to quantify the problem and track success
- Remove a significant portion of the population

By 2015, the project resulted in the removal of 73% of the total biomass as well as documentation of carp movements during the spawning and winter aggregation periods. Aquatic vegetation frequency of occurrence increased from 21% to 66% by 2014, providing habitat for the fishery. Chlorophyll-a concentrations were measured below and secchi depth was slightly above their 10 year averages.

Perseverance and Innovative Problem Solving Culminate in Wirth Lake Delisting

Greg Wilson (gwilson@barr.com), Jim Herbert, and Karen Chandler, Barr Engineering Company; Jim de Lambert and Laura Jester, Bassett Creek Watershed Management Commission; Jeff Oliver, City of Golden Valley

Even among Minnesota lakes that have been delisted for excess nutrients, Wirth Lake is an anomaly—a hypereutrophic, deep lake in an urbanized watershed that was completely restored without the use of chemical or other in-lake treatments.

Several water quality improvements have been made in the lake's watershed since 1982 through the concerted and coordinated efforts of the Bassett Creek Watershed Management Commission, the cities of Golden Valley and Minneapolis, the Minneapolis Park and Recreation Board, and the MPCA and BWSR's Clean Water Legacy Fund. Careful analysis of lake conditions and water and phosphorus flux in the TMDL study indicated that significant amounts of phosphorus entered the lake during periods of high flow in Bassett Creek, representing the last major source of excess nutrients. To address this source, the lake's outlet was modified to prevent creek water from flowing into the lake while maintaining the normal lake level and outflow capacity of the existing outlet and without raising creek flood levels. Cumulatively, all watershed implementation projects have resulted in Wirth Lake's water transparency being four times higher than it was in 1994. Watershed and in-lake monitoring/modeling results will be presented along with a discussion of key considerations for BMP selection and construction.

Concurrent Session IV 10:00 – 11:30 a.m.

LID Workshop

This special all day session on low impact development (LID) and stormwater management continues the conversation from the 2013 International Low Impact Development Symposium. Part I of the session will consist of a keynote presentation on LID & stormwater BMP implementation models and lessons learned from the Chesepeake Bay by Tom Schueler, Executive Director of Chesapeake Stormwater Network. Part II of the workshop session will feature an update on state of adoption and implementation of the Minnesota MIDS – Minimal Impact Design Standards including performance goals, calculator, the Community Assistance Package, and examples of implementation. Part III will include a presentation and discussion on stormwater research priorities and discussion around a proposal to create a stormwater research council. Participants in this session will still attend the Wednesday morning welcome, plenary session, lunch, luncheon presentation, and breaks with all conference attendees. This workshop session will be led by John Bilotta, University of Minnesota.

Part I: Lessons Learned in Managing Stormwater at New and Existing Development in the Chesapeake Bay Watershed

Tom Schueler, Executive Director of Chesapeake Stormwater Network

This presentation will feature the approaches and implementation of stormwater management and policy in the Chesapeake Bay Region with an emphasis on volume control, impervious surface management, pollution prevention, stormwater runoff quality improvement practices, lessons learned, and comparisons to Minnesota approaches.

Luncheon Presentation 12:15 p.m. – 1:00 p.m.

Reflections on Water

Len Price, Conservation Corps Minnesota and Iowa

Concurrent Session V 1:15 p.m. – 2:45 p.m.

Track A: Mapping Technologies

An Improved National Wetland Inventory for Southern Minnesota

Steve Kloiber (steve.kloiber@state.mn.us) , Minnesota Department of Natural Resources; Dave Rokus and Andy Robertson, Geospatial Services, St. Mary's University of Minnesota

The National Wetland Inventory (NWI) is an essential tool for wetland management and restoration planning. It is the only spatially comprehensive wetland inventory for Minnesota; however, the original NWI is about 30 years out-of-date. Many changes in wetland extent and type have occurred since the original inventory was completed. Changes in land use have resulted in wetland loss, while changes in wetland policies and programs have resulted in wetland gain. Wetlands have been re-mapped and re-classified for 38 counties in southern Minnesota (23,900 square miles). These data were created using a combination of high-resolution, multi-spectral aerial imagery, various lidar-derived datasets, as well as soils and other ancillary data. A rigorous quality control program was implemented including the use of a web-based tool for end-user review of draft data and a random sample of 1887 field sites used to test the accuracy of the final data. The overall accuracy for separating wetland from upland was 94% and the overall accuracy for assigning the specific wetland class was 83%. In addition to the standard set of wetland classification attributes, the new NWI data for southern Minnesota also include hydrogeomorphic classification attributes that enhance the capability of the data to evaluate potential wetland functions. The improvements and enhancements to the data will be presented.

Regional Lake Water Quality Measurements Using New Enhanced Satellite Remote Sensing Systems

Leif G. Olmanson (olman002@umn.edu), Patrick L. Brezonik (brezonik@umn.edu), Jacques C. Finlay (jfinlay@umn.edu) and Marvin E. Bauer (mbauer@umn.edu), University of Minnesota

Recent advances have enabled use of satellite imagery for regional scale-measurement of lake characteristics beyond water clarity. The 2013 launch of Landsat-8 and expected 2015 launch of the ESA Sentinel-2 expand the capability to measure chlorophyll, CDOM, suspended sediment, the main determinants of water clarity. To explore the potentials of these systems, we measured optical water quality characteristics and in situ reflectance spectra nearly contemporaneously with satellite imagery. Sites were selected to obtain wide ranges of concentrations of CDOM, chlorophyll, and suspended sediment, the primary factors affecting reflectance. Landsat 8 and simulated Sentinel-2 data were used to develop water quality models. Both systems worked well for CDOM and water clarity; Sentinel-2 was able to distinguish inorganic sediment from chlorophyll. The ability to measure these variables on a regional basis will greatly enhance our understanding of spatial variability and responses to environmental change in surface waters and improve lake management.

Mapping Minnesota's Next Generation of Hydrography (NXG-Hydro) from LiDAR-Derived Products

Sean Vaughn (sean.vaughn@state.mn.us), Minnesota Information Technology at Minnesota Department of Natural Resources

LiDAR-derived digital elevation models (DEMs) have become a commonly-applied product used by resource managers to represent the landscape and surface water movement. This presentation begins discussing hydro-terrain analysis procedures being implemented across Minnesota's DEM landscape to generate hydrography for water quantity and quality modeling. Capitalizing on the ability of LiDAR to capture topographic water conveyance features, we will introduce terrain roughness analysis products and techniques. A DNR product named hydrography position index (HPI), created to exploit these water conveyance features, will be presented as a backdrop base-hydrography illustration for heads-up digitizing and QA/QC of DEM hydro-terrain analysis products. The technique of creating segmented linear hydrography will be introduced as a way to create "DEM extracted" watercourses used to expedite the mapping of hydrography features as part of the Governor's Buffer Initiative. We conclude discussing the culmination of LiDAR-derived hydrography for developing Minnesota's next generation of hydrography.

Concurrent Session V 1:15 p.m. – 2:45 p.m.

Track B: Stream Restoration

Using Natural Channel Design to Restore Both Physical and Ecological Function to Unstable Streams. How a system based approach to setting objectives led to the Stewart River Natural Channel Design restoration project

Ann Thompson (ann.thompson@co.lake.mn.us) and Dan Schutte (dan.schutte@co.lake.mn.us), Lake County Soil and Water Conservation District; Keith Anderson (keithanderson@tsa3.org), NE Technical Service Area Engineer; Karl Koller (karl.koller@state.mn.us), Minnesota Department of Natural Resources

Single goal approaches to address impairments on streams often result in undesirable outcomes. This presentation will review past completed projects to examine shortcomings of that approach and alternatives if broader objectives had been defined. Using a more holistic approach can move us away from projects that focus on single goals and towards broader objectives that restore stream functions. A template for setting comprehensive, system-based goals to direct stream restoration will be discussed and a 4000-foot restoration project on the Stewart River, which utilized Natural Channel Design principles, will be described. System-based objectives determined by the project team directed design methods and implementation. Objectives addressed include: reducing sediment, enhancing habitat, maintaining or improving water temperatures and hydrology, restoring floodplain connectivity and transporting sediment. The presentation will show that using a system-based approach to set project objectives results in successful long-term restorations that enhance ecological and geomorphic stream functions.

Geomorphic Characteristics, Processes, and Responses of Duluth-Area Streams

Christopher Ellison (cellison@usgs.gov), Faith A. Fitzpatrick (fafitzpa@usgs.gov), United States Geological Survey

On June 19 – 20, 2012, heavy rainfall produced severe flooding in tributaries to Lake Superior near the city of Duluth, Minnesota. In 2013, the U.S. Geological Survey (USGS) revisited 48 streams that had previously (2003) been included in a USGS geomorphic assessment of Duluth-area streams. Channel bed material, woody debris, bank erosion, depositional bars, pools, and bank stability measurements were collected and compared to measurements from the 2003 study to document their response to the 2012 flood. Changes in channel bed material indicated that larger (cobble) sizes had been replaced by smaller (gravel) sizes and large wood in streams had declined by more than 70 percent. Aggradation of the streambed, loss of pool habitat, scouring, and widening of channels also were observed in the 2013 study. These data provided important insights on stream and ecosystem responses to flood events and offered valuable information for future stream and ecosystem management.

Ravine Erosion, Baseflow and Private Property: an Urban Stormwater Management Trifecta

Anna Eleria (anna@capitolregionwd.org), Capitol Region Watershed District; Todd Shoemaker (tshoemaker@wenck.com), Wenck Associates

With a State Clean Water Fund Grant, Capitol Region Watershed District (CRWD) stabilized four ravines east of Saint Paul's Highland Park in fall 2014. The Highland Ravine Stabilization Project is located within a 100-foot woodland bluff in Saint Paul that had several incised, eroded ravines as well as baseflow from groundwater seeps. Slope instability caused periodic residential property damage, polluted the Mississippi River, and prompted residents to petition CRWD to address the issues. The stabilization plan used a combination of bioengineering and traditional engineering techniques including rock grade control structures; brush bundles and vegetated rip-rap; pipes on the steepest slopes; revegetation with native plants; and a stormwater basin. CRWD estimates the project reduces annual sediment loads by more than 30 tons and total phosphorus loads by 10 pounds. Project challenges included wet, muddy conditions due to constant groundwater seepage and securing permission from and coordinating with private homeowners.

Concurrent Session V 1:15 p.m. – 2:45 p.m.

Track C: Ag and Water Quality

Changes in hydrology and water quality after conversion of of perennial vegetation to cropland in southwest Minnesota

David Tollefson (david.tollefson@state.mn.us), Minnesota Department of Agriculture; Jeffrey Strock (jstrock@umn.edu), University of Minnesota, Southwest Research and Outreach Center; Adam Birr (abirr@mncorn.org), Minnesota Corn Growers Association

This field experiment used a paired watershed design with two small watersheds of perennial vegetation with no history of soil disturbance (tillage) to examine surface water hydrology and water quality characteristics. In addition, soil bulk density and infiltration capacity were examined before and after conversion to crop production. The treatment watershed was converted to crop production following a calibration period. Runoff was limited throughout the experiment because of weather variability, and represented 0.26 and 1.16 percent of the precipitation received in the control and treatment watersheds, respectively, throughout the 4 year monitoring period. Runoff from the control watershed was observed only during frozen soil periods. Runoff from the treatment watershed was observed during both non-frozen and frozen soil periods. The hydrology and water quality characteristics of perennial vegetation on undisturbed soils will be presented along with the changes observed in the first two years of crop production.

Climate Effects on Nitrogen Losses from a Tile Drained Watershed in Southern Minnesota

Satish Gupta (sgupta@umn.edu), Andrew Kessler (kessl127@umn.edu), and Melinda Brown (brow2113@umn.edu), University of Minnesota

Agricultural drainage in the Upper Midwestern United States has been linked to excess nitrogen in rivers and subsequently hypoxic conditions in the Gulf of Mexico. This study evaluated the effects of a changing climate on N losses from the Le Sueur River watershed in Southern Minnesota. The calculations for N losses are based on the premise that baseflow in rivers is a reflection of tile flow in the landscape. We tested this hypothesis using seven year average baseflow from the Le Sueur River against the corresponding average tile flow data of Randall and Vetch (2005) for Waseca, Minnesota. Seven year average baseflow for the growing season equaled 127±49 mm as compared to average measured tile flow of 150±85 mm for corn and 135±89 mm for soybean for the fall applied fertilizer treatment in Randall and Vetch (2005). Since growing season length varies from year to year, we used the relationship of growing season baseflow vs. annual baseflow for seven years to predict growing season baseflow from 1950 to 2009. The predicted seasonal baseflow was then multiplied with 0.125 kg-N/ha/mm of baseflow (Randall and Vetch, 2005) to estimate annual N losses from the corn-soybean rotation in Le Sueur River watershed. Predicted N losses for 1976-2009 equaled 13.2 kg-N/ha as compared to 7.6 kg-N/ha for 1950-1975. This is equivalent to a 73.7% increase in N losses relative to the 1950-1975 period. Plots of annual N losses vs. precipitation for the 1950-1975 and 1976-2009 were statistically not different (p=0.085). A lot of five year moving average N losses against precipitation showed that the relationship between N losses and precipitation is about same but higher N losses in recent years were concentrated at higher precipitation levels.

Concurrent Session V 1:15 p.m. – 2:45 p.m.

Track C: Ag and Water Quality (continued)

Nitrates in Drainage Water in Minnesota

Brad Carlson (bcarlson@umn.edu), University of Minnesota Extension; Jeff Vetsch (jvetsch@umn.ed) and Gyles Randall (grandall@umn.edu), University of Minnesota Extension

Nitrates in surface water have long been identified as an issue. Efforts to reduce mass flow of nitrate are guided by the USEPAs Gulf Hypoxia Action Plan and Minnesota's Nutrient Reduction Strategy. Artificial drainage systems installed in agricultural areas are a significant pathway for nitrates to move to surface water. This presentation will discuss the results of close to forty years of research conducted at the University of Minnesota's Southern Research and Outreach Centers in Waseca and Lamberton. Much of the research shows that Minnesota's Best Management Practices for Nitrogen fertilizer do a good job of minimizing nitrate loss, yet probably do not provide a solution to reducing nitrate flux to the point in which reduction targets are met. Data indicates much of the loss is due to mineralization from soil organic matter and is affected significantly by climatic variability. A full understanding of these dynamics will be essential to finding solutions which are effective.

Concurrent Session V 1:15 p.m. – 2:45 p.m.

Track D: Advances in Wastewater Research and Assessment

Performance of a Composite Bioactive Membrane for Enhanced Bioh2 Production and Capture from Wastewater

Ana Lucia Prieto, William Arnold, and Paige Novak, University of Minnesota Department of Civil, Environmental, and Geo Engineering

Water and wastewater treatment accounts for 3% to 4% of the annual energy demand in the US. The opportunities for waste to energy conversion using anaerobic technologies are abundant, especially if applied to overcome the actual energy demand of wastewater treatment. In this study, a synthetic composite bioactive membrane was tested to recover clean energy from wastewater. Hollow fiber membranes were functionalized using encapsulated acidogenic bacteria to simultaneously produce and capture H2 from waste streams. Under anaerobic conditions and pH from 4.5 to 5.5, an average of 21 mL H2/g hexose were recovered from synthetic sewage, corresponding to 57% of the total H2 production in the bioreactor. Further, the H2 capture efficiency was improved by coating the modules with a thin film of polymeric silica gel. The silica-coated modules produced about 28 mL H2/hexose and the hydrogen capture efficiency increased to 73%. These results suggest that about 2.5 kWh/m3 excess energy could be generated from the treated influent in a wastewater treatment facility. To our knowledge, this study is the first to report efficient production/capture of H2 from wastewater using bioactive membranes.

The Effect of Antibiotic Use on Raw Sewage in Municipal Wastewater Treatment Plants

Kyle Sandberg (sandb283@umn.edu) and Timothy LaPara (lapar001@umn.edu), University of Minnesota, Department of Civil, Environmental, and Geo- Engineering

The increased prevalence of antibiotic resistant bacteria represents a serious public health concern; our research hopes to gain a better understand of the mechanisms by which antibiotic resistance spreads. Our hypothesis is that fecal material represents a major reservoir of resistance and that wastewater treatment facilities can be applied to ameliorate this reservoir. In this study, we compared the bacterial community composition of different sources of raw sewage to discern whether different levels of medical activity lead to higher levels of antibiotic resistance. Quantitative polymerase chain reaction was used to quantify levels of different antibiotic resistance genes in wastewater samples, and next-generation, high-throughput DNA sequencing (Illumina) of 16S rRNA genes fragments was used to compare the bacterial community composition between different sewage sources. The results show that Cities with higher antibiotic use have higher concentrations of antibiotic resistance genes in their sewage, but that the structures of the bacterial communities within sewage were similar.

Estrone Removal in Treatment Systems Designed for Nitrogen Removal

Kira N. Peterson (pete6676@umn.edu), David T. Tan (tanxx253@umn.edu), and Paige J. Novak (novak010@umn.edu), University of Minnesota

Establishment of new rules regarding total nitrogen levels in WWTP effluent may result in widespread implementation of nitrogen removal technologies. Conventional nitrification systems do not remove total nitrogen, instead only oxidizing ammonia to nitrate, however they do successfully degrade estrogens. One estrogen, estrone (E1), is often the primary contributor to the estrogenicity of WWTP effluent. The objective of this work is to provide guidance on the impact that changes in wastewater treatment practice will have on estrogen removal by comparing E1 degradation in conventional nitrification with that in wastewater treatment technologies designed to remove total nitrogen. E1 removal was assessed in the following lab scale systems: conventional treatment (>90% E1 removal), Modified Ludzack-Ettinger (>90% E1 removal), granulated sludge sequencing semi-batch reactor (no E1 removal) and sequencing semi-batch reactor (>90% E1 removal). The project will conclude in summer 2015 with studies assessing E1 removal in both ANAMMOX and SHARON systems.

Concurrent Session V 1:15 – 2:45 p.m.

LID Workshop

This special allday session on low impact development (LID) and stormwater management continues the conversation from the 2013 International Low Impact Development Symposium. Part I of the session will consist of a keynote presentation on LID & stormwater BMP implementation models and lessons learned from the Chesepeake Bay by Tom Schueler, Executive Director of Chesapeake Stormwater Network. Part II of the workshop session will feature an update on state of adoption and implementation of the Minnesota MIDS – Minimal Impact Design Standards including performance goals, calculator, the Community Assistance Package, and examples of implementation. Part III will include a presentation and discussion on stormwater research priorities and discussion around a proposal to create a stormwater research council. Participants in this session will still attend the Wednesday morning welcome, plenary session, lunch, luncheon presentation, and breaks with all conference attendees. This workshop session will be led by John Bilotta, University of Minnesota.

Part II: The State of the Minnesota MIDS (Minimum Impact Design Standards) An Update on implementation, Adoption, and Case Studies Including the Status of MN MIDS Including Performance Goals, Calculator, and the Community Assistance Package

Led by: Anne Gelbmann, Minnesota Pollution Control Agency

Concurrent Session VI 3:00 p.m. – 4:30 p.m.

Track A: Wild Rice: Research and a Tool for Economic Evaulation for Traditional Values

MPCA's proposal for protecting wild rice from excess sulfate

Edward Swain (Edward.swain@state.mn.us) and Phil Monson (phil.monson@state.mn.us), Minnesota Pollution Control Agency

The Minnesota Pollution Control Agency is proposing that rather than relying on a single sulfate level to protect all wild rice waters, a protective sulfate level should be calculated for each wild rice water, based on location-specific factors. In coming to this conclusion, the MPCA sampled over 100 waters to examine how sulfate affects wild rice. The study found that:

- In the sediment in which wild rice is rooted, sulfate from the surface water is converted to sulfide by bacteria.
- Higher levels of sulfide in the sediment porewater create an environment that is less hospitable to wild rice.

However, certain factors change the efficiency of net conversion of sulfate to sulfide. Most significantly, higher levels of iron can lead to less sulfide, and higher levels of organic carbon can lead to more sulfide. The agency proposes to calculate a protective sulfate concentration for each wild rice water from iron and organic carbon data derived sampling from the sediment where wild rice grows.

Accounting for Traditional Values: an Ecosystem Services Valuation for the St. Louis River watershed

Nancy Schuldt (nancyschuldt@fdlrez.com), Fond du Lac Band of Lake Superior Chippewa; Angela Fletcher (afletcher@eartheconomics.org), Earth Economics

Human development has permanently altered significant elements of the natural landscape of the St. Louis River watershed, resulting in diminishment of ecological processes and services that support healthy living and well-being for humans and wildlife. However, this large watershed still retains substantial areas of intact and interconnected forests, wetlands, waterbodies and riparian zones that provide a wide range of provisioning, supporting, regulating and cultural services. The Fond du Lac Band, working with tribal, state and federal partners, is seeking to capture and communicate the economic value of the ecological services inherent in our primary watershed, located predominantly within the boundaries of the 1854 Ceded Territory where signatory bands retain hunting, fishing and gathering rights. Our objective is to offer a more comprehensive accounting of the values and benefits that a healthy watershed provides, not only to the bands but to the public at large.

Concurrent Session VI 3:00 p.m. – 4:30 p.m.

Track B: Rivers

Identifying Hotspots of Channel Migration in the Minnesota River Basin

Jonathan A. Czuba (czuba004@umn.edu) and Efi Foufoula-Georgiou (efi@umn.edu), University of Minnesota, Twin Cities; Karen B. Gran (kgran@d.umn.edu), University of Minnesota, Duluth; Patrick Belmont (patrick.belmont@usu.edu) and Peter R. Wilcock (wilcock@usu.edu), Utah State University

Intensification and expansion of agriculture, combined with climatic trends in the last few decades, have altered streamflows and affected sediment generation and transport in the Minnesota River Basin, where most sediment is now sourced from near-channel river banks and bluffs. Our work identifies channel-migration hotspots at the watershed scale, highlighting reaches that may migrate faster than average due to sediment persistence (as one possible mechanism for channel migration). In a numerical model, we both (1) instantaneously and uniformly and (2) at known sediment sources, inject sediment to the Greater Blue Earth River network and track these inputs through the network using process-based time delays that consider uniform flow hydraulics and at-capacity sediment transport. Our results show that locations where river-bed sediment has a tendency to persist correspond to observed channel-migration hotspots suggesting they might be due to sediment deposition on point bars forcing bank erosion and thus channel migration.

Riding the Wave of the Latest Dam Breach Modeling: HEC-RAS 2D

Paul Dierking (paul.dierking@hdrinc.com), HDR Engineering, Inc., Amanda Smith (amanda.smith2@mn.usda.gov), Natural Resources Conservation Service

Dam safety, risk assessment, and emergency preparedness are critical components for flood risk management. Historically, resource limitations have allowed only basic methodologies and tools to be used for routing of dam breach conditions, providing simplified results with limited value for emergency planning. Recent advancements in hydraulic modeling now provide more robust evaluations with high levels of efficiency, allowing significant increases in value to emergency planners and the public for the same cost. These techniques and tools were recently applied by the Minnesota NRCS for numerous dam assessments across the state. Case studies of several dam breach routings using HEC-RAS 2D will be presented demonstrating specific information including flow depths, velocities, arrival times, and visualization of breach inundation. This important information will provide more detailed information for local sponsors to complete and/or update emergency action plans for their communities.

Minnesota River Bank Stabilization Results

Shanna Kent (shanna.kent@state.mn.us) and Scott Morgan (scott.morgan@state.mn.us), Minnesota Department of Transportation

During the 2011 spring floods of the Minnesota River, a portion of river bank eroded and collapsed within 30' of the TH 169 highway just north of St. Peter. After some research, it was noticed that flooding over the years has reduced the space between the highway and the river from over 100' down to 30'. As a result, MnDOT prepared plans to stabilize and protect the river bank using riprap, live willow stakes on a vegetated bench and bendway weirs through an emergency contract. Initial channel surveys indicated several very deep areas of scour along bank of the channel bend. Revisiting the site and comparing the latest channel surveys demonstrate the effectiveness of bendways weirs after a couple of year. Future reviews will help to determine the long range effectiveness of the bendway structures.

Concurrent Session VI 3:00 p.m. – 4:30 p.m.

Track C: Ag Drainage/Storage

Conservation Drainage: Innovative Strategies that Provide Win-Win Solutions

Chuck Brandel (chuck.brandel@is-grp.com), ISG; Craig Austinson (craig.austinson@blueearthcountymn.com), Blue Earth County Ditch Authority

Inefficiencies in Blue Earth County Ditch 57 affected agricultural economics and reduced water quality due to flushing sediment and nutrients downstream. The objective of this project was to increase drainage capacity and water quality throughout system.

Surge basins, buffer strips, a two-stage ditch, a rate control weir and culvert structures were installed to control flow rates and allow sediment and nutrients to settle out of suspension before continuing downstream. Buffer strips provide nutrient uptake and trap sediment prior to entering the ditch. Weir structures divert and dissipate the peak flow rates resulting in less sediment and nutrients traveling downstream.

During the 2013 rain season, storm events greater than 0.5" were analyzed for water quality. 2013 peak flow rates at the control weir at the outlet of the system were reduced by 55%. Average reductions for surge basin: peak flow 77%, TSS 47%, TP 63%, and TN 60%. Average reductions for two-stage ditch: TSS 10%, TP 8%, TN 19%.

A Landscape-Level Analysis to Identify Drainage Water Management Opportunities

Jennifer Olson (Jennifer.olson@tetratech.com) and Peter Cada, Tetra Tech

Major changes in the corn belt since the 1940s, including a shift away from small grains and forage crops to corn and soybeans and use of larger machinery, have enhanced the need for tile drainage. While artificial drainage has greatly increased crop yields while helping to reduce surface erosion, drainage may result in significant potential water quality issues including increased transport of dissolved nitrogen and phosphorus to surface waters and other hydrologic and water quality challenges. The purpose of this project was to provide relevant information on drainage water management (DWM) to inform local planning decisions and funding priorities.

This US EPA Region 5 project was completed in 2014 and provided an important opportunity to develop and implement a GIS-based approach to approximate tile drained agricultural land in major watersheds (HUC8 scale), as well as an analysis to recommend specific DWM practices including controlled drainage, constructed wetlands, bioreactors, and saturated buffers at smaller scales. DWM practice selection criteria were developed to identify the most applicable DWM practices using available spatial datasets including slope of fields, where tile drain outlets were expected, riparian vegetation, and soils. The approach was piloted in two Ohio watersheds tributary to Lake Erie and two Michigan watersheds in the Saginaw Bay watershed. The methodology and results were reviewed with local NRCS and state agency staff and limited field verification was conducted.

This presentation will focus on the technical aspects of the project and resulting outcomes which included spatial representation of priority implementation areas and a DWM practice selection matrix. Key challenges and lessons learned will be discussed including recommendations for future similar studies.

Concurrent Session VI 3:00 p.m. – 4:30 p.m.

Track C: Ag Drainage/Storage (continued)

Linking Water Storage BMPs to Watershed Goals

Jessica Nelson (Jessica.nelson-1@mnsu.edu), Water Resources Center, Minnesota State University, Mankato; Jim Klang (jklang@kieser-associates.com), Kieser & Associates, LLC

Targeting conservation efforts through a balance of practices that keeps soil in place, temporarily stores water and addresses near channel sources will help rural watersheds meet water quality standards. Water storage was identified by Minnesota's Nonpoint Source Management Program Plan as an effective way to reduce pollutants, along with peak runoff flow and rate reductions. A water storage benefits calculator was developed and vetted using an Excel spreadsheet to measure the watershed-scale results for structural and vegetative practices – surface impoundments, soil organic matter, and subsurface controlled drainage. The calculator is calibrated using new and existing water storage projects. Additionally, "Water Storage Learning Group" comprised of landowners and natural resource professionals was established to inform how water storage looks in rural watersheds. Individual projects to large-scale watershed goals can be quantified in volume and rate of storage, which can be used to better inform targeting decisions at the state and local-level.

Concurrent Session VI 3:00 p.m. – 4:30 p.m.

Track D: Contaminants in Our Waters

Neonicotinoid Pesticides in Minnesota Groundwater

Brennon Schaefer (Brennon.schaefer@state.mn.us) and Bill VanRyswyk (bill.vanryswyk@state.mn.us), Minnesota Department of Agriculture

This presentation will discuss results from groundwater monitoring for neonicotinoid pesticides. Neonicotinoids are currently one of the most widely used classes of insecticides in the world and are of particular concern for pollinators. The Minnesota Department of Agriculture (MDA) collects and analyzes pesticide groundwater samples from many areas of the state to assess the impacts from routine use of agricultural chemicals. The MDA laboratory began analyzing for three neonicotinoid pesticides in groundwater samples in 2010 following laboratory upgrades and the development of expanded analytical methods. Currently the MDA analyzes groundwater samples for six neonicotinoid pesticides. The monitoring data indicates neonicotinoid detections occur most frequently in shallow groundwater in the Central Sands Region of Minnesota. Statewide, and region-specific, groundwater neonicotinoid detection frequency and concentration data will be discussed and compared to applicable human health-based reference values.

Wetland Pesticide Monitoring in Minnesota

Matthew Ribikawskis (Matthew.Ribikawskis@state.mn.us), William VanRyswyk (Bill.Vanryswyk@state.mn.us), and David Tollefson (David.Tollefson@state.mn.us), Minnesota Department of Agriculture

In 2014, the Minnesota Department of Agriculture (MDA) conducted pesticide monitoring of water column and benthic wetland sediment samples from 19 wetlands across Minnesota. To evaluate whether pesticide detection may be variable by land-use, three wetland land-use classes were targeted: agricultural, urban, and reference (non-human impacted). Water column samples were analyzed for 133 different pesticides compounds, including six neonicotinoid insecticides. Twenty-seven pesticide and pesticide degradate compounds were detected in at least one wetland and the majority of the detected compounds were herbicides or herbicide degradates. Three fungicides and three insecticides (two neonicotinoid compounds) were also detected in water column samples. Benthic wetland sediment samples were analyzed for 14 neonicotinoid related insecticide compounds, with a single detected imidacloprid degradate compound found in two urban wetlands. MPCA provided assistance with site selection and sample collection. Pesticide detection by wetland type, pesticides detected and associated monitoring will be discussed.

Sources, Transport, and Sediment-Water Distributions of Contaminants of Emerging Concern in a Mixed-Use Watershed

David Fairbairn, William Arnold, Brian Barber, M. Ekrem Karpuzcu, and Elizabeth Kaufenberg, University of Minnesota-Twin Cities; William Koskinen, United States Department of Agriculture-Agricultural Research Service and University of Minnesota-Twin Cities; Paige Novak, University of Minnesota-Twin Cities; Pamela Rice, United States Department of Agriculture-Agricultural Research Service and University of Minnesota-Twin Cities; Deborah Swackhamer, University of Minnesota-Twin Cities

Understanding the spatiotemporal occurrence patterns of contaminants of emerging concern (CECs) is crucial for assessing their sources, fate, and impacts. This project investigated the sources, transport, and distribution of a diverse set of CECs in surface waters in a mixed-use watershed. Concentrations and loadings of CECs in water and sediment were analyzed in light of land use, seasonal, hydrologic, and physicochemical variables. Distinct groups of CECs showed similar instream profiles and sources that were identified based on proportional source loading, spatiotemporal patterns in concentrations and loading, and sediment-water distributions. While some CECs have previously shown ubiquitous and mixed sources that were difficult to characterize, results of this study show that spatiotemporal patterns in concentration and loading can be used to trace their sources and transport. These methods and results can be applied to inform CEC monitoring programs, models, screening/risk assessments, and pollution prevention/mitigation strategies in a wide range of settings.

Concurrent Session VI 3:00 – 4:30 p.m.

LID Workshop

This special allday session on low impact development (LID) and stormwater management continues the conversation from the 2013 International Low Impact Development Symposium. Part I of the session will consist of a keynote presentation on LID & stormwater BMP implementation models and lessons learned from the Chesepeake Bay by Tom Schueler, Executive Director of Chesapeake Stormwater Network. Part II of the workshop session will feature an update on state of adoption and implementation of the Minnesota MIDS – Minimal Impact Design Standards including performance goals, calculator, the Community Assistance Package, and examples of implementation. Part III will include a presentation and discussion on stormwater research priorities and discussion around a proposal to create a stormwater research council. Participants in this session will still attend the Wednesday morning welcome, plenary session, lunch, luncheon presentation, and breaks with all conference attendees. This workshop session will be led by John Bilotta, University of Minnesota.

Part III: Stormwater Research Priorities and Establishing a Stormwater Research Council

Led by: Cliff Aichinger, John Gulliver, and John Chapman

Poster Session 4:45 p.m. – 5:45 p.m.

1. Using HSPF in TMDL Development

Drew Ackerman (drew.ackerman@respec.com), Julie Blackburn (julie.blackburn@respec.com), Cindie McCutcheon (cindie.mccutcheon@respec.com), and Bruce Wilson (bruce.wilson@respec.com), RESPEC

Water resource managers often face conflicting challenges in addressing and mitigating water quality issues. One issue is developing an accurate quantification of the source of the impairment and understanding the conditions that lead to those degraded conditions. The HSPF watershed model has been extensively applied throughout Minnesota to represent surface and subsurface hydrologic and water-quality processes and the fate and transport of nutrients, chlorophyll and dissolved oxygen in the State's streams, rivers and lakes. Knowing how those models are utilized in developing TMDLs to restore impaired waterways is critical so all stakeholders have an understanding of the targeted management actions. This presentation will provide a background on HSPF model application development and how continuous simulation models have been used in developing TMDLs and load allocations with examples provided for TSS and dissolved oxygen.

2. Minnesota Hydrogeology Atlas: a State-Wide Compilation Series for Minnesota's Hydrogeology

Roberta Adams (roberta.adams@state.mn.us), Jim Berg (jim.a.berg@state.mn.us), and Todd Petersen (todd.petersen@state.mn.us), Minnesota Department of Natural Resources

The Minnesota Department of Natural Resources, Ecological and Water Resources Division, is compiling a series of maps from the County Geologic Atlas program as well as other miscellaneous maps and reports, in order to provide the public with accessible state-wide hydrogeology. The series will include Near-Surface Pollution Sensitivity, Bedrock Surface Pollution Sensitivity, Water Table Elevation and Depth, Potentiometric Surfaces for various bedrock units, and others. Some maps in the series will be updated to reflect the current availability of data and method; others will contain legacy data that is applicable in a more regional setting. This series will be available in online as maps with accompanying reports and spatial data. This work is supported by the Environment and Natural Resources Trust Fund.

Poster Session 4:45 p.m. – 5:45 p.m.

3. Stormwater Utility Referendum Adoption - Non Profit's Approach for Success

James Bachhuber (jbachhuber@brwncald.com) and Caroline Burger (cburger@brwncald.com), Brown and Caldwell

Many local governments are seeking funding sources that are fair and stable to meet growing stormwater management needs. Over the past 20 years, stormwater utilities have become a common approach for many communities in the Midwest, however this approach still faces stiff challenges to obtain public acceptance. Adopting new utilities in Wisconsin became even more difficult with the state's adoption of legislation in 2013 (known as Act 20). Specifically, if a municipality wished to adopt a stormwater utility after July 2013, and fund services that were previously partially or fully funded through general revenue source (Ad valorem, or property taxes), the municipality must reduce the utility revenue from the property tax by an equal amount. With the addition of this state legislated requirement, much of the incentive for developing a stormwater utility was removed. An exception to this requirement was provided in Section 1271p 66.0602 (2m) (b) subd. 4). If a resolution were approved by public referendum stating that the levy limit need not be reduced by a like amount, then the local government could generate funds through the utility, without reducing levy limit funds. Based on past experience, the likelihood of public approval of a referendum establishing a new municipal fee was remote.

In October, 2013, the city of Middleton, WI adopted enabling ordinances for the establishment of a stormwater utility fee system. The ordinances were approved with the following condition: "adopt an Ordinance to Create a Storm Water Utility with a delayed effective date of such a time that Council has adopted a resolution, which has been approved in a referendum, that the levy limit need not be reduced to satisfy Wis. Stats. 66.0602(2m)(b)2." This condition meant that the stormwater utility would not be in effect until such time as a public referendum was passed. The referendum was scheduled for November 4, 2014.

When the city government decided it could not advocate for the approval of the referendum, a local not-for-profit conservation group took up the challenge gain public support for the referendum and the stormwater utility. The Friends of Pheasant Branch Conservancy (FOPBC) is a 501(c)(3) organization with a stated mission of: "To Restore, Protect and Promote the Pheasant Branch Conservancy and its watershed for now and for future generations to come". The organization was formed in 1995 and has a paying membership of approximately 500.

The Watershed Committee of the FOPB formed a subgroup and developed a written referendum campaign plan in February, 2014. The document laid out a 10 month public information campaign. Early planning allowed the group time to: identify: 1) key public information needs, 2) sources of referendum opposition, 3) messages to address the opposition's concerns, 4) media approaches that would be employed, and 5) resources and funding that would be required. The committee also quickly identified to need to engage the services of a media and marketing professional. Pro bono services were provided and this guidance greatly helped to focus the group's message and avoid low benefit media approaches.

On November 4, 2014 the following question was put before the public via a general referendum: "Shall the City of Middleton Storm Water Utility be permitted to charge customers of the Storm Water Utility an annual charge up to $15.00 per equivalent runoff unit for each property for maintenance of existing storm water management facilities without reducing the levy limit for the charges of the Storm Water Utility?" The referendum was overwhelmingly approved by a 65% - 35% margin making it the first approved referendum in Wisconsin under the requirements of 2013 Act 20. This presentation will describe the public information plan developed by the FOPBC, the targeted activities on a limited budget, the selection of media outlets, and lessons learned from the campaign. This information will be valuable to local governments and other organizations seeking public approval for controversial utility programs and in forming successful public – private partnerships.

Poster Session 4:45 p.m. – 5:45 p.m.

4. Modeling Management and Vegetation Impacts on Nutrient, Sediment and Water Flow Changes in the Redwood River

Nathaniel Baeumler, University of Minnesota; Brent Dalzell, University of Minnesota, Department of Soil Water

The objectives of this research were to understand and quantify the ability of land use changes and best management practices to mitigate sediment and nutrient loss from the Redwood River watershed. We employed the SWAT model to simulate increases in buffer strip implementation as well as to evaluate broader land cover changes in an effort to quantify water quality responses to watershed-scale practices. Preliminary project results showed that widespread buffer strip implementation achieved significant decreases in sediment, and phosphorous reduction (>50% in some cases), with smaller reductions in nitrogen (~10%). Ongoing work will also evaluate the environmental outcomes of various BMPs and land cover changes under varying weather scenarios.

5. Co-Occurrence Patterns for Contaminants of Emerging Concern in Tributaries to the Great Lakes

Mark Brigham (mbrigham@usgs.gov), United States Geological Survey; Joann Banda (joann_banda@fws.gov) and Steven Choy (Steven_Choy@fws.gov), United States Fish and Wildlife Service; Sarah Elliott (selliott@usgs.gov), United States Geological Survey; Daniel Gefell, United States Fish and Wildlife Service; Richard Kiesling (kiesling@usgs.gov) and Kathy Lee (klee@usgs.gov), United States Geological Survey; Jeremy Moore (jeremy_n_moore@fws.gov), United States Fish and Wildlife Service; Heiko Schoenfuss (hschoenfuss@stcloudstate.edu), Saint Cloud State University

Water and bottom-sediment samples were collected from more than 200 sites across 17 Great Lakes tributary basins and analyzed for a broad suite of contaminants of emerging concern (CECs) including hormones, pharmaceuticals, alkylphenols, pesticides, and fire retardants. Two-dimensional cluster analysis identified groups of co-occurring CECs, and groups of sites with similar CEC fingerprints. Chemical composition reflected land use and targeted point sources. Greater concentrations and more complex mixtures were observed at sites downstream from point sources than sites draining other settings; pharmaceuticals and hormones represented a large portion of the CEC composition at these sites. In contrast, pharmaceuticals and hormones were typically lower at agricultural sites where atrazine, metolachlor, and isophorone (a widely used solvent for pesticides) represented a large portion of CECs. Results from this study will help guide multiple-contaminant fish-exposure laboratory experiments, and help guide future management and restoration activities.

Poster Session 4:45 p.m. – 5:45 p.m.

6. Rethinking Teaching and Learning Stormwater Practices: A National Resource for Professionals

Eleanor Burkett (burke044@umn.edu) and Shahram Missaghi (miss0035@umn.edu), University of Minnesota

Human activity on the landscape has drastically changed the natural hydrologic cycle by directing much of the precipitation output into excessive surface water runoff. The consequences of this excessive runoff have been severe and large-scale, and have included flash flooding, loss of property and significant water quality degradation. Since the 1980's, a national effort called green infrastructure has focused on remedying the problem by providing a series of tools to minimize the impact of human development by mimicking natural hydrology. Recently, there has been rapid growth in the number of publicly available stormwater educational programs for professionals and communities that focus on green infrastructure tools (often casually referred to as stormwater management practices, in this document we use the more exact term stormwater management practices). However, much of the growth has been "locally-based," addressing specific local needs and issues, publicly available, comprehensive national stormwater core curriculum has been missing.

The goal of this collaboration is to develop a uniform, publicly-available, research-based stormwater core curriculum that can be readily used by educators, local governments and professionals. In addition this course will provide:

- accessible, no or low cost education for managers and educators who do not have the time or resources for development, enabling them to learn stormwater basics and the skills to teach others,
- coordinated education, developed by professional educators, that is cost-effective, so that multiple agencies do not need to create multiple training programs.

The target audience for this curriculum includes stormwater professionals and communities such as public works and parks department staff, private contractors, stormwater managers and, homeowners associations or other land owners who are responsible for a stormwater management practice.

7. On-Farm Phosphorus Import/Export Analysis to Improve Water Quality

Les Everett (evere003@umn.edu), University of Minnesota Water Resources Center; Jose Hernandez (jahernan@umn.edu) and Randy Pepin (pepin019@umn.edu), University of Minnesota Extension

The objective was to identify strategies for land-limited livestock operations to avoid excessive build-up of soil test phosphorus (P) while maintaining production and economic returns. Imports of P in fertilizer, feed, bedding, livestock and other inputs were compared with exports of P in livestock, milk, grain, and other outputs for more than twenty dairy and beef farms in Minnesota. We identified strategies used by some of these operations and others to reduce import/export imbalances, including reducing P in livestock rations, eliminating P starter fertilizer on very high P testing soils, reduce heifer inventory and freshen more in 22-24 months, convert to sand bedding, separate manure solids for transport to more distant fields or recycle as bedding, and others. Case studies were prepared and presented at 22 producer workshops, and are being posted on the UM Extension Manure Management website: http://z.umn.edu/manure

Poster Session 4:45 p.m. – 5:45 p.m.

8. Mercury in Odonata Larva in the St. Louis River Estuary

Daniel Fraser (fras0081@d.umn.edu), University of Minnesota Duluth; Jeff Jeremiason (jjeremia@gustavus.edu), Gustavus Adolphus College; Nathan Johnson (nwjohnso@d.umn.edu) University of Minnesota Duluth

Mercury levels in fish of the St. Louis River Estuary are elevated with respect to the upstream portion of the river and Lake Superior. Since methylmercury is transported from the upstream watershed, the extent to which mercury from estuary sediment contributes to fish mercury is not known with certainty. Total- and methyl- mercury were quantified in Odonata (dragonfly) larva collected in June and August 2014 from the SLRE and portions of the upstream river. Larva were identified to family level and frozen for later analysis. Consistent with fish mercury results, Odonata showed elevated levels of total- and methyl- mercury in the SLRE compared to the upper river. Since most estuary Odonata were collected in lentic habitats, it is not yet clear whether the high mercury content of estuary Odonata relative to upstream Odonata was due to higher mercury bioavailability in the estuary, differences in food web structure, or other factors.

9. A New Resource for Assessing Contaminants of Emerging Concern in Minnesota Waters

Christopher Greene (christopher.greene@state.mn.us), Minnesota Department of Health; Sarah Elliott (selliott@usgs.gov), United States Geological Survey

Contaminants of emerging concern (CECs), including pharmaceuticals, personal care products, plasticizers, and pesticides, are a subject of increasing interest to risk managers concerned with drinking water quality and ecosystem health. In order to prioritize chemicals for further study, it is vital to have access to occurrence data for CECs in multiple environmental media. The U.S. Geological Survey (USGS) has long been at the forefront of environmental monitoring of CECs, but the data, being derived from multiple studies over many years, have not always been available in a consistent format. The Minnesota Department of Health (MDH) has partnered with USGS to compile and organize environmental monitoring data pertaining to CECs in Minnesota waters spanning the years of 1999 through 2013. Data were extracted from published reports and the USGS National Water Information System (NWIS), and reformatted to be consistent in chemical nomenclature and units of measurement. The resulting database contains over 100,000 records derived from 18 published reports and eight studies accessed from the USGS NWIS. MDH has used the database to quickly and efficiently identify detections of CECs under review, and to identify heretofore unexamined chemicals to be considered for toxicological review and development of drinking water guidance. The database is being made available to interested parties upon request. This project was funded in part by the Clean Water, Land, and Legacy Amendment (Minnesota Constitution, Article 11, Section 15.) and the USGS Cooperative Water Program.

10. Quantifying Thermal Loading to Brown's Creek

William Herb (herb0003@umn.edu), University of Minnesota; Camilla Correll (ccorrell@eorinc.com)and Mike Majesky (mmajeski@eorinc.com), Emmons & Olivier Resources

Brown's Creek is a thermally impaired trout stream located in the St. Croix River basin near Stillwater, Minnesota. To develop guidance for the Brown's Creek Watershed District for reducing the impairment of Brown's Creek, the project described here assembled temperature models for the main stem of Brown's Creek and for sources of baseflow and stormwater input. The models were calibrated with a combination of instream flow and temperature measurements, piezometer data from source wetlands, and LiDAR data to set the spatial variability of riparian shading. The models simulate temperatures at sub-hourly time steps during both baseflow conditions and storm events, utilizing an existing XPSWMM model to supply surface runoff inputs. The models are being used to evaluate the sensitivity of temperature exceedance frequency to riparian shading, baseflow inputs, and stormwater inputs. This information will be used to help prioritize future water management for thermal load reduction.

Poster Session 4:45 p.m. – 5:45 p.m.

11. Using Artificial Floating Islands to Limit Sediment Resuspension in Shallow Lakes

Bryce Hoppie (bryce.hoppie@mnsu.edu) and Kelly Hunt (kelly.hunt@mnsu.edu), Minnesota State University, Mankato

Strong winds degrade water quality in shallow lakes by resuspending bottom sediment and nutrients. To assess the impact of artificial floating islands on sediment resuspension in shallow lakes, eight scale models with and without islands were assembled in a greenhouse using actual lake water and sediment; the models were then subjected to calm, low (2.2 ms-1), medium (4.9 ms-1) and high (9.4 ms-1) wind conditions for nine days. Wave attributes, TSS, NO3-, TP, and chlorophyll-a, were measured regularly during each (n=3) test. Notable results include: 1) At 9.4 ms-1, floating islands reduced TSS by 100x and TP by 3x; 2) chlorophyll fluctuations were irregular, possibly due to limited NO3- availability; 3) at 4.9 ms-1 and 9.4 ms-1, sediment accumulated beneath the islands indicating that they behave as floating breakwaters. Thus, this experiment shows that floating islands can limit wind-driven sediment resuspension and promote improved water quality in shallow lakes.

12. Quantifying the Iron-Based Sulfide Absorption Capacity of Aquatic Sediment and Iron Minerals

Nathan Johnson (nwjohnso@d.umn.edu), Aaron Mika, and Nicholas Osmundson (osmun037@d.umn.edu), University of Minnesota Duluth

In many cases, sulfide accumulation in porewaters of freshwater sediment exposed to elevated sulfate depends on the quantity of iron present in sediments. We tested the capacity of aquatic sediments and an iron carbonate mineral (siderite) to sequester added sulfide and remove it from the aqueous phase in batch and column laboratory experiments. When sulfide was added incrementally to sediment, little sulfide was present in porewater until solid phase sulfide exceeded solid phase iron stoichiometrically. In batch experiments, both iron-containing aquatic sediment and siderite were capable of removing sulfide produced via sulfate reduction. Laboratory-scale columns with a residence time of 6 days were fed lactate-amended water containing >600 mg/L sulfate. In the columns, the rate of iron release and overall sulfide absorption capacity from siderite was related to surface area and mass of the iron amendment.

13. Scenario Application Manager (SAM): a Statewide Implementation Decision Support Tool

Seth Kenner (Seth.Kenner@respec.com) and Julie Blackburn (Julie.Blackburn@respec.com), RESPEC

The Scenario Application Manager (SAM) has been scaled from its 2014 original pilot phase and will be available for statewide application. This watershed-scale decision support tool is adapted for Minnesota to facilitate prioritization and placement of best management practices (BMPs) to achieve nutrient, sediment, and flood reductions goals as well as develop protection strategies for minimally impacted resources. The decision-support framework consists of a Geographic Information System, HSPF model, and BMP database. The BMP database was developed by assigning costs and reduction efficiencies to common practices based on literature research and the University of Minnesota's NBMP and PBMP tools. The combination of the graphical interface, a state-accepted watershed model, practical BMPs which can be easily incorporated into the model, and cost optimization allows water resource managers to be intimately involved with developing implementation and nutrient reduction plans.

Poster Session 4:45 p.m. – 5:45 p.m.

14. Highway 99 Slope Repair Project

Shanna Kent (Shanna.kent@state.mn.us) and Scott Morgan (Scott.morgan@state.mn.us), Minnesota Department of Transportation

Adjacent to Minnesota Highway 99 between St. Peter and Cleveland a very large erosion problem was discovered just beyond the thick grove of Sumacs. Remnants of 2 metal pipes were exposed, one of them hanging in the air at least 10 feet above the flow line of a ravine. Near vertical slopes threatened the neighboring landowners and the drainage infrastructure and the road inslope supporting MN 99. In addition to determining a low impact, sustainable repair for this site, access, rapid turnaround on easements and constructability were great challenges also.

15. Fundamental Watershed Factors Influencing the Transport of Nitrogen to Streams

Scott Kronholm (kron0108@umn.edu), University of Minnesota; Paul Capel (capel@usgs.gov)and Silvia Terziotti (seterzio@usgs.gov), United States Geological Survey

Recursive partitioning and random forest regression modeling were used to determine which geospatial, environmental, and watershed variables in 636 small (<585 km2) watersheds across the Nation significantly affect loads, yields, and concentrations of total nitrogen. Initial analysis led to the separation of watersheds into three groups based on dominant land use (agricultural, developed, and undeveloped). As few as three variables explained as much as 76 percent of the variability in total nitrogen loads for watersheds with predominantly agricultural land use. A series of multiple linear regression equations utilizing the extracted variables then were developed and applied to estimate total nitrogen in all small watersheds in Minnesota.

16. Nitrate Leaching Flux in Bare Mineral Soils

Stephen Labuz (labuz011@umn.edu) and John Nieber (nieber@umn.edu) University of Minnesota

Agricultural fields and stormwater management practices are two potential sources of nitrate leaching because they utilize effective drainage and have areas of bare soil. This research investigates nitrate leaching from five individual storm events in bare soil with effective drainage. Three constructed tanks (A, B, and C) were filled with soil and fitted with drain pipes. Tank A's and B's pipes were stuffed with sand enhanced with iron or grass seed in attempt to remove nitrate from discharging water. Effluent water samples were collected and measured for nitrate. Nitrate concentrations were highest at the beginning of each event. All three tanks continuously contributed nitrate proving there is nitrate leaching in bare soils. The tanks with stuffed drain pipes contributed less nitrate than the unstuffed pipe without dramatically prolonging drainage showing potential for further research and possible implementation.

Poster Session 4:45 p.m. – 5:45 p.m.

17. Sulfur, Iron and Carbon Geochemistry in the Rooting Zone of Wild Rice

Sophie LaFond (lafo0062@d.umn.edu), Water Resource Science Program, University of Minnesota; Nate Johnson (nwjohnso@d.umn.edu), Department of Civil Engineering, University of Minnesota; John Pastor (jpastor@d.umn.edu), Department of Biology, University of Minnesota Duluth

In anoxic sediment, sulfide production and accumulation rate depends on sulfate, dissolved organic carbon, and iron. Sulfate and iron were added to and litter was removed from wild rice mesocosms in a factorial design over two growing seasons. After the first growing season, porewater sulfide was correlated with overlying sulfate, but litter removal and iron additions did not affect porewater sulfide concentrations significantly. In separate experiments amended with 300 mg/L sulfate, wild rice roots were sacrificed biweekly for simultaneous iron and AVS weak acid extraction. Both iron and AVS were more concentrated on roots compared to bulk sediment. Bulk sediment AVS increased from 0.3 umol/g to 13 umol/g over one growing season, while root AVS increased to 130 umol/g in late summer. During senescence, root iron and AVS decreased precipitously to concentrations similar to the bulk sediment. These results suggest that iron and sulfur cycling occurs dynamically near root surfaces.

18. Rice Creek Commons Infrastructure Improvements

Jonathan Libby (jon.libby@kimley-horn.com), Kimley-Horn & Associates, Inc.; Pamela Massaro (pmassaro@wenck.com), Wenck Associates, Inc.

Ramsey County and Arden Hills are planning for the redevelopment of the former Twin Cities Army Ammunitions Plant (TCAAP) site after purchasing the property from the US government. This 427 acre parcel in Arden Hills was listed as a Superfund site in 1983 due to groundwater and soil contamination, and is undergoing environmental remediation and demolition to be completed this year. Public infrastructure improvements are being designed to facilitate redevelopment, including roadways, utilities, re-meander of Rice Creek, trails, regional wetland mitigation and drainage ponds to serve the overall development. The largest development parcel in Ramsey County will become Rice Creek Commons, a mixed-use development with walkable neighborhoods, balanced green space, and water resources amenities. Phased implementation, mass grading and earthwork balance, a comprehensive stormwater management plan, shallow groundwater, remaining groundwater distribution system including monitoring/extraction wells, meeting regulatory requirements, and minimizing development constraints were the key challenges to defining project solutions.

19. Pickle Pond - Remediation to Restoration in the St. Louis River Area of Concern

Dendy Lofton (dlofton@limno.com), LimnoTech; Steve Choy (steven_choy@fws.gov), United States Fish and Wildlife Service; Matt Steiger (matthew.steiger@wisconsin.gov), Wisconsin Department of Natural Resources

Nine beneficial use impairments (BUIs) have been identified in the St. Louis River Area of Concern (SLRAOC), which shares a boundary with Minnesota and Wisconsin. Multiple efforts are currently underway to address the sources of impairments in prioritized sites, which includes legacy sediment contamination, habitat degradation, and excessive sediment and nutrient inputs. Strategies and actions to address the BUIs at these remediation to restoration (R2R) sites have been identified by agencies and stakeholders with the ultimate goal of delisting the SLRAOC. Pickle Pond, a 9-acre sheltered bay in Superior, Wisconsin, had limited historical data that indicated legacy sediment contamination, particularly in the southeast end of the pond. Through a 2013 field investigation, we found elevated concentrations of PAHs, PCBs, and heavy metals in the sediments throughout the pond. Currently, we are conducting a feasibility study to address data gaps and evaluate restoration design alternatives.

Poster Session 4:45 p.m. – 5:45 p.m.

20. Creek Restoration Action Strategy

Joshua Maxwell (jmaxwell@rpbcwd.org), Riley Purgatory Bluff Creek Watershed District; Jeff Weiss, Barr Engineering; Michelle Jordan, Riley Purgatory Bluff Creek Watershed District; Shanna Braun, Barr Engineering; Claire Bleser, Riley Purgatory Bluff Creek Watershed District; Scott Sobiech, Barr Engineering

Prioritizing creek restoration projects can be challenging, especially when reaches span multiple, and/or interacting waterbodies. The Creek Restoration Action Strategy (CRAS) is a tool for identifying stream reaches in greatest need of restoration, beginning with consistent assessment of creek conditions. In developing the CRAS, eight important prioritization categories were identified and grouped into two tiers: Tier I - infrastructure risk, channel stability, public education, ecological benefits, and water quality; Tier II - project cost, partnerships, and watershed benefits. Tier I assessment utilizes primarily field data and is applied at all reaches. Priority reaches identified by Tier I assessment then undergo Tier II ranking to inform final project selection. This tool is being implemented across three creeks within the Riley Purgatory Bluff Creek Watershed District, and will allow the district to focus efforts on high-benefit projects in a cost-effective manner.

21. Estimation of Suspended Sediment Concentrations in a Sandy Minnesota River Tributary Using an in Situ Turbidity Meter

Gustavo Merten (mertengh@gmail.com), University of Minnesota Large Lakes Observatory Duluth; Paul Capel (capel@usgs.gov), United States Geological Survey

Data from in situ turbidity meters can be used to estimate suspended-sediment concentrations (SSC) in surface waters in hydrologic systems where turbidity correlates well with SSC. Sand particles can attenuate the intensity of light scattering, thereby affecting the relationship between turbidity and SSC. To investigate the effect of sand particles, a turbidity meter was installed in a sandy Minnesota River tributary (USGS station number 0532700) from May-October 2013; concurrent SSC samples were collected using depth-integrated isokinetic equipment. In the laboratory, SSC and percentages of sand and fines (< 62 mm) were determined. Even though sand was a high percentage of total suspended sediment (median value = 43%), the relation between turbidity and SSC was very strong (R2 = 0.96), while the relation between streamflow and SSC was poor (R2=0.30). Results suggest that in situ turbidity meters can be used to compute suspended sediment concentrations and loads in sandy rivers.

22. Application of Agricultural Best Management Practices in a Rural Ontario Watershed Using PCSWMM

Cecilio Olivier (colivier@eorinc.com), Ryan Fleming (rfleming@eorinc.com), Olivia McGuire (omcguire@eorinc.com), and Michael Talbot (mtalbot@eorinc.com), Emmons & Olivier Resources, Inc.

As agricultural production has continued to expand and intensify around the world, many models have been developed to predict of the down-stream impacts on water quality and quantity due to changes in on-farm management practices. In rural watersheds with complex stormwater conveyance systems, models designed for agricultural landscapes tend to inadequately represent the spatial and temporal resolution required in the simulation of hydraulic systems. The Storm Water Management Model (SWMM) was originally developed for urban watershed modelling, but its robust hydraulic simulation capabilities have been applied in conjunction with new tools developed within PCSWMM in order to simulate the downstream impacts of a suite of agricultural BMPs in a watershed in rural Ontario, Canada. Three simulation scenarios were run and results are reported for a single model subcatchment. Runoff rates and volumes were shown to be reduced, and water quality results show general agreement with literature reported nutrient reduction values.

Poster Session 4:45 p.m. – 5:45 p.m.

23. Clear Lake Water Quality Improvements

Tim Olson (timol@bolton-menk.com), Bolton & Menk, Inc.; Kyle Axtel (kaxtell@ricecreek.org), Rice Creek Watershed District

The City of Forest Lake and Rice Creek Watershed District (RCWD) partnered to develop a successfully awarded Clean Water Legacy (CWL) grant for water quality improvements in a 500 acre watershed draining to Clear Lake. The total grant amount awarded was $382,000 with a local match of $95,500. Clear Lake is identified as a Tier 1 (high quality) lake within the RCWDs Watershed Management Plan but does not meet the nutrient goals established by the RCWD. The lake has been routinely monitored and the Clear Lake Diagnostic Study and Management Plan estimated a 140 pound reduction in annual total phosphorus (TP) loading would be necessary to meet the District's water quality goals. In conjunction with the construction of the Forest Lake City Center, a large water quality improvement practice was proposed to treat regional stormwater runoff prior to discharge to Clear Lake.

Originally, the project included 4 bioretention basins and a large wet sedimentation basin for TP removal. While groundwater is relatively high in the vicinity of the project, a second approach was proposed and designed to further target the dissolved component of the TP load through the use of iron enhanced sand filters (IESF). The project consists of two tree trenches and a multi-faceted treatment train practice. The tree trenches were outfitted with "Rain Guardian" pre-treatment structures. The trench was lined with an EPDM rubber liner and back filled with structural soils to store water and promote adequate tree growth. A bioretention swale was constructed on the west side of the property to accommodate and treat an additional 20 acres of commercial property that discharges untreated to Clear Lake. A rock gabion weeper structure is situated at the downstream end of the bioretnetion swale, serving a dual purpose. During low flows, stormwater will drain through the gabion weeper to filter larger diameter particles. As runoff enters the bioswale, water elevations will increase and pass through an integrated IESF. Sand bags were filled with the iron/sand blend and placed in a void space left in the middle of the gabion weeper. Approximately 500 acres flows into the east side of the site through a regional ditch system. The main channel was diverted into a new bypass channel that has a similar rock gabion and IESF weeper to force water to bounce during high flows. Stormwater then flows over a flat bioretention floodplain before spilling into a perched IESF. As water subsides, the perched IESF drains through a perforated tile and water in the channel flows through the gabion weeper and iron/sand bags. The system will treat runoff up to a 5-year rainfall event and is anticipated to remove approximately 120 lbs/year TP. Final stabilization of the projected concluded in early May, 2015. RCWD will continue the Clear Lake Diagnostic study by monitoring flow into and out of the practice to measure long term TP removal.

24. Forest to Field Conversion: Nitrate Loss from Irrigated Crops on Coarse Textured Soils Recently Converted from Forest to Cropland

Ryan Perish (ryan.perish@state.mn.us) and Luke Stuewe (luke.stuewe@state.mn.us) Minnesota Department of Agriculture. This poster presentation will include contributions from multiple organizations including: Minnesota Department of Agriculture, U of M Extension, Central Lakes College, and RD Offutt Corporation

Recent conversions of forested lands into irrigated row crop production in Minnesota have drawn interest from a wide range of organizations, agencies and other stakeholders across the state. A collaborative, long-term field study began in 2014 to monitor nitrate loss below one recently converted field and to monitor nitrate levels in groundwater. To accomplish these goals, the field has been instrumented with suction tube lysimeters, drain gauges and monitoring wells. The poster presentation will highlight the field's instrumentation and monitoring program.

Poster Session 4:45 p.m. – 5:45 p.m.

25. Exploring Local Capacity to Protect Groundwater

Amit Pradhananga (prad0047@umn.edu), University of Minnesota; LeAnn Buck (leann.buck@maswcd.org), Minnesota Association of Soil and Water Conservati; Mae Davenport (mdaven@umn.edu), University of Minnesota; Sharon Pfeifer (sharon.pfeifer@state.mn.us), Minnesota Department of Natural Resources

Soil and Water Conservation Districts (SWCD) are essential to on-the-ground implementation. For this reason, the Minnesota Department of Natural Resources, Minnesota Association of Soil and Water Conservation Districts, and University of Minnesota conducted a statewide survey of SWCD staff to assess staff knowledge and resources to address local groundwater issues. Survey results also informed the development of a series of customized capacity-building workshops for SWCD staff and locally elected officials. This project applies the Social Measures Monitoring System (Davenport 2013) and is the first of its kind investigating local capacity for groundwater management. Study results revealed a majority of respondents believe that their SWCD brings people together to share knowledge about groundwater. However, most also reported a lack of programmatic support for groundwater protection. Study findings will inform funding initiatives, statewide planning efforts, capacity-building programs, and groundwater protection.

26. Protecting Rural Transportation Infrastructure from Increasingly Intense Rain Events and Debris Flows - CSAH 6 and CSAH 12 Flood Repair, Sibley County, MN

Eric Roerish (eroerish@srfconsulting.com), SRF Consulting Group, Inc.; Tim Becker (timb@co.sibley.mn.us) Sibley County

The rainfall patterns in July, 2014, were record setting, causing record flood levels in many local lakes, creek and river flooding, and bank erosion within many counties in the area. Impacts of intense rains and high peak flows were exacerbated by downed trees and debris flows that redirected water into road embankments and adjacent bluffs, and plugged inlets which cause roadway overtopping and failure. Many counties were declared disaster areas making them eligible for disaster relief, including Sibley County.

Sibley County had a number of areas with major flood damage, including a ravine crossing on CSAH 6 and numerous ravine washouts along a 1.5 mile stretch of CSAH 12. A variety of measures were considered in restoring the damage, including geosynthetic liners, compound pipe/overflow swale systems, and a strategic removal of existing vegetation to name a few. This presentation will cover the multitude of design and funding considerations, assumptions, and selection of restoration measures. With construction occurring in the summer of 2015, the presentation will also cover any construction issues.

27. Optimizing Performance of Stormwater Infrastructure With Real Time Controls: Success Stories and Applicability to Agricultural Drainage Systems

David Roman (droman@geosyntec.com), Andrea Braga (abraga@geosyntec.com), and David Richardson (drichardson@geosyntec.com), Geosyntec Consultants

New and existing urban stormwater infrastructure (e.g., detention basins, infiltration galleries) are increasingly being identified as opportunities for projects to reduce the impacts of urbanization on natural receiving waters. Recent advances in technology, known as the "Internet of Things", are providing inexpensive opportunities to achieve higher performance for urban stormwater controls including flow reduction, minimized flooding risk, and water quality improvements.

This presentation will highlight the installation and operation of a range of projects where new and existing urban stormwater infrastructure including basins, cisterns, and infiltration galleries have been optimized with real time controls using the OptiRTC® platform. This presentation will also look at similarities between those urban stormwater controls being used today and the best management practices currently being developed to meet similar objectives for agricultural drainage systems. Potential project applications such as real-time automated flow control for new and existing agricultural drainage systems will be discussed.

Poster Session 4:45 p.m. – 5:45 p.m.

28. Statewide Riparian Buffer Inventory of Minnesota's Rivers and Streams

John Sandberg (john.sandberg@state.mn.us) and Andrew Petersen (andrew.peterson@state.mn.us), Minnesota Pollution Control Agency

Riparian buffers provide known benefits to water quality and aquatic habitat, and the current condition of buffers along Minnesota's waterways has gained recent attention from policymakers. To date, no accurate and precise statewide inventory of riparian buffer conditions exists for Minnesota's rivers and streams. Obstacles to such an evaluation include: a) the spatial resolution and accuracy of algorithmically-classified land cover data, and b) the time required to complete detailed, comprehensive land cover classification using "improved" methods such as visual interpretation of high-resolution aerial photography. The MPCA's Environmental Monitoring and Assessment Protocol (EMAP) design offers an opportunity to estimate the condition of riparian buffers at a statewide scale by carrying out detailed GIS air photo interpretation at a limited number of stream locations. The stratified random design of the EMAP program allows extrapolation of these results to the full population of Minnesota's rivers and streams. While this method cannot be used to evaluate riparian buffer conditions at specific locations outside of the EMAP design, it can provide accurate condition estimates at statewide and ecoregional scales. Buffer condition has been evaluated at different spatial scales, ranging from 15 meters (~50 feet) to 100 meters.

29. Field Guide for Maintaining Rural Roadside Ditches

Jesse Schomberg (jschombe@d.umn.edu), University of Minnesota Sea Grant; Dr. Valerie Brady (vbrady@d.umn.edu), Natural Resources Research Institute

In three rural NE Minnesota watersheds (Sucker, Knife, and Poplar Rivers), miles of ditch channel approximately equal the miles of stream channels (assuming a ditch on both sides of every road); thus essentially doubling the network of drainage channels. Discussions with road and conservation personnel about what could be done with roads and ditches to reduce the impacts of stormwater runoff on streams highlighted a need for a ditch maintenance guide specific to this region that could be used for training of road and ditch maintenance workers (Brady and Breneman 2008). Over the past 3 years we have developed a "Field Guide for Maintaining Rural Roadside Ditches". The guidebook focuses on proper routine maintenance of rural roadside ditches, with a major focus on helping maintenance workers identify what problems are serious enough that the advice of a supervisor or engineer is recommended. Out of 30 evaluations to-date, most thought the field guide would help improve water quality or reduce environmental impacts of ditch maintenance (86% = yes).

30. RPDCWD Guided On-Line Permitting Management Tool

Kelly Spitzley (kelly.spitzley@hdrinc.com), HDR, Inc.; Claire Bleser (cbleser@rpbcwd.org), Riley-Purgatory-Bluff Creek Watershed District

Riley-Purgatory-Bluff Creek Watershed District (District) and HDR, Inc. created a centralized online permitting guide and database to help developers, consultants, and agencies understand how watershed District rules and requirements apply to projects in a personalized, guided manner. A web-based system was developed within the District's website to manage permit applications.

A Content Management System framework served as the foundation for building the application submission form and manager. Applicants create an account to apply and view their application's status. Likewise, the District can administer permit applications, and track, modify, and print customized documents from the system to facilitate the review and approval process. To help applicants determine which rules apply to their permit application, an on-line guide was developed. This guide uses a series of questions providing the applicant a personalized report, exhibits checklist, for permit submittal. The result is an improved permitting process that facilitates water resources protection.

Poster Session 4:45 p.m. – 5:45 p.m.

31. Filling the Gaps: Water Science At the Frontiers of Environmental and Social Change

Kate Thompson (thom2117@umn.edu), University of Minnesota

Long-term, spatially continuous, water and environmental data is prohibitively expensive to produce. Consequently, water researchers scale back research agendas to limit costs associated with data collection in the field, or confine their questions to available data, which often lack the spatial and temporal continuity to address regional environmental impacts from climate change, and land use patterns.

I present original survey data from government, non-profit, academic, and industry representatives characterizing current and future labor needs and skill gaps. Results suggest that technical competencies in data collection and monitoring require specialized on-the-job training that traditional degree programs do not serve. I propose an alternative training method that fills these skill gaps, and lowers labor costs. A review of the literature identifies freshwater rivers as the highest priority for implementing new monitoring capacity.

32. Cedar River - Watershed Modeling Project

Bill Thompson, Minnesota Pollution Control Agency; Jim Solstad, Minnesota Department of Natural Resources; Greg Wilson, Barr Engineering Co.; Nick Gervino, Minnesota Pollution Control Agency; Bev Nordby, Cedar River Watershed District and Mower Soil and Water Conservation District

From 1990 – 2014, the Cedar River Watershed in Minnesota has been the focus of five modeling efforts. Initially, these efforts were considered "stand-alone" projects, to address a specific need. However, as additional resources have been targeted to non-point source implementation, models are being used more frequently to provide flow and pollutant load predictions based upon various BMP scenarios. By having several watershed models developed for the entire watershed (SWAT in 2013; XP-SWMM in 2013; HSPF in 2014), comparisons can be made on such practical factors such as the cost and time to develop, as well as calibration issues, and model outputs. There have also been three projects in the Cedar using watershed models at the subwatershed scale or smaller. Several of these efforts have been completed on the Dobbins Creek drainage (25,000 acres), which is now an active targeted watershed implementation project sponsored by the CRWD/Mower SWCD. This is turn has provided the opportunity to compare modeling activities and results for more robust models (GSSHA, SWAT), and assess the possible use of small-scaled modeling data to inform the broader, more coarse full-scale watershed models. We will overview if the different models explicitly address tile drainage, or what calibration factors are adjusted to compensate for a lack of specific tile simulation routines. There has also been some assessment on which models are likely to be maintained and used for the long run, by whom, and at what cost?

33. Modeling Basin Runoff Variability and Compliance to River Standards: Case Studies from Northern and Southern River Nutrient Regions of Minnesota

Bruce Wilson (bruce.wilson@respec.com) and Julie Blackburn (julie.blackburn@respec.com), RESPEC

Advances in state-of-the-science lake, wetland, groundwater, stream monitoring coupled with increasingly sophisticated GIS and associated databases have resulted in significant strides in better understanding Minnesota's water resources. Many HSPF model applications have been developed throughout the State to detail land and subsurface hydrologic and water-quality processes which closely integrate corresponding stream, wetland and reservoir processes. With these tools, we can estimate continuous flows, nutrients and dissolved oxygen levels throughout the system, not only at the monitoring locations. The response of each system under varying climatic and environmental conditions, both monitored and unmonitored, can be characterized. This information can help provide an understanding of factors contributing to critical conditions and variability in the system. This presentation will review the use of HSPF to define rehabilitation goals, use of the model to understand the variability in the monitoring data, the factors influencing that variability and how to improve targeting of impairment sources.

Poster Session 4:45 p.m. – 5:45 p.m.

34. Feasibility of Using Industrial Anion Exchange Resin to Remove Nitrate from Tile Water

Kari Wolf (wolfx648@umn.edu) and Dr. Satish Gupta (sgupta@umn.edu), University of Minnesota

Presence of nitrate in tile water is one of the major environmental challenges facing Midwestern agriculture. This project evaluated the feasibility of using industrial anion exchange resin to remove nitrate from tile water. The resin is commonly used by water works departments and can be repeatedly recharged with solution containing chloride anions. Laboratory leaching of 100 mg L-1 nitrate solution through the 50 mL resin column showed retention of 13.3 g of nitrate per kilogram of the resin. Breakthrough curve showed center of the mass appearing at 310 pore volume with a partitioning coefficient of 141; a nearly instantaneous retention. After nitrate leaching, the resin was recharged with sodium chloride (NaCl) solution and the waste water containing sodium nitrate was incubated with wood chips to denitrify nitrate. Further studies are underway to assess (1) the use of potash solution as a recharging agent, thus recycling waste water as a KNO3 fertilizer, and (2) the frequency with which to recharge resin under field conditions.

35. Retrofitting the Miller Hill Mall for Trout: Modeling and Designing Green Infrastructure That Decreases the Temperature of Stormwater Runoff

Heather Wright Wendel (hwrightwendel@barr.com) and Erin Anderson Wenz (eandersonwenz@barr.com), Barr Engineering Co.

Miller Hill Mall is located within a highly developed commercial district of Duluth, Minnesota and is directly adjacent to Miller Creek, a designated trout stream with a temperature impairment. A stormwater management plan is being developed in partnership with the South St. Louis Soil and Water Conservation District and the Mall to provide a strategy for lowering the temperature of stormwater runoff from the Mall's 66-acre site through the implementation of green infrastructure features. This grant-funded project utilized a runoff temperature model developed by the St. Anthony Falls Lab at the University of Minnesota (MINUHET) calibrated to Miller Hill Mall. Modeling results indicate that the largest thermal reductions will come from capturing the first flush of precipitation events. Utilizing the temperature model to evaluate the impacts of different site features, proposed design improvements were evaluated to identify the most cost- effective approach to mitigate temperature and other non-point source pollutants.